EDITORIAL

HAVING pioneered television for home entertainment, England now finds herself in a most unenviable position in the matter of transmission standards. While other nations, like Australia, have benefited by her experience and have built their systems on modern practice, England is committed to standards established prior to World War II.

Currently, several factors are conspiring to force reassessment of these standards, with the possibility of their ultimate abandonment in favour of the 625-line system already in operation in Australia and elsewhere.

Factor number one is England's need for more television outlets and a possible extension into the UHF region. Many see in this an opportunity to introduce new standards, operating in parallel with the present VHF services, but gradually displacing them. Opponents of the scheme point to the crop of technically "untidy" dual-standard receivers, which would inevitably follow.

Factor number two is the growing importance of Eurovision and the complications which arise when signals have to jump the standards barrier. Again, the opponents are very vocal. They maintain that it is not good enough to scrap an entire domestic television system to satisfy technical niceties.

Again, in England as elsewhere, viewers are showing a preference for larger screens, which certainly don't flatter the 405-line system. "Use spot wobble" say the opponents, but viewers show a marked disinclination to do so.

What seems to have sparked off the controversy is the B.B.C.'s campaign to commence colour television. This comes as a consummation of work by B.B.C. engineers to adapt the NTSC colour method to the British standards. They probably see in it, also, an opportunity to steal a march on their commercial competitors.

Feelings on this score have run so high that the powerful Pye organisation recently threatened to set up a rival 625-line colour service and, further, advised their dealers henceforth to "talk up" the whole 625-line proposition. With England's TV receiver industry in the doldrums, a change in standards would mean new business and facilitate production for export.

Meanwhile, at a technical level, there is constant skirmishing between protagonists of the new order and those who doggedly support the established standards, 405 lines, AM sound and positive modulation included.

England is indeed at the television cross-roads and one cannot but feel sympathy for those who will shortly have to make a choice. Whatever that choice, it is bound to be unpopular. What's more, there's the horrible possibility that England may manage to get its television system changed over just in time for some new development in basic techniques.

Williams

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RADIO ★★ TELEVISION AND HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION HOBBIES AND POPULAR SCIENCE

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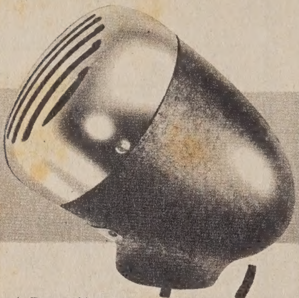
OUR COVER PICTURE

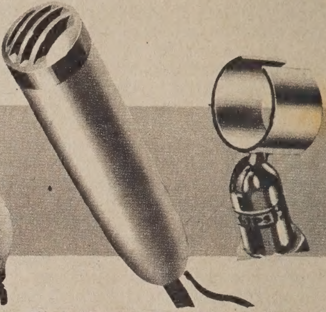
Regarded as a typical smock mill of mid Kent is the West Kingsdown Windmill which the local council is restoring at a cost of £4,500. The workmen shown are busy on the framework of the mill's new 30ft sails.

Which PHILIPS microphone is best for your purpose?

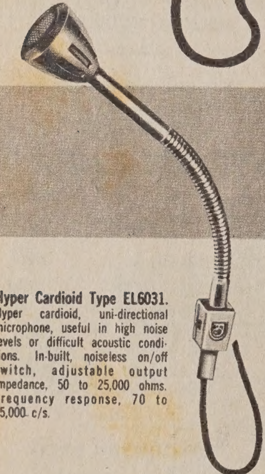


Dynamic Type 1100 or 1101. Here is a robust, general-purpose microphone giving reliable service and excellent intelligibility even under high-ambient noise levels. Available in 50 ohms. or high impedance. Frequency response, 100 to 7,000 c/s.

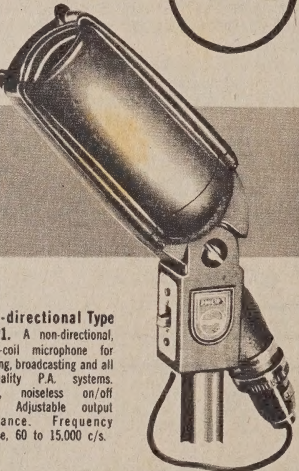
Dynamic Type 1114 or 1115. Recommended for tape recording and general stage work. Styled for hand use or stand mounting. Frequency response, 100 to 10,000 c/s.



Pencil Microphone Type 1116 or 1117. Ideal for general studio use (for roving and orchestral pick up) and all applications requiring a high-quality microphone. Frequency response, 35 to 15,000 c/s.



Hyper Cardioid Type EL6031. Hyper cardioid, uni-directional microphone, useful in high noise levels or difficult acoustic conditions. In-built, noiseless on/off switch, adjustable output impedance, 50 to 25,000 ohms. Frequency response, 70 to 15,000 c/s.



Omni-directional Type EL6021. A non-directional, moving-coil microphone for recording, broadcasting and all high-quality P.A. systems. In-built, noiseless on/off switch. Adjustable output impedance. Frequency response, 60 to 15,000 c/s.

Moving Coil "Pencil" Type EL6040. For highest quality broadcasting and stage work. In-built, noiseless on/off switch and adjustable output impedance, 50, 500, 25,000 ohms. Frequency response, 35 to 15,000 c/s.

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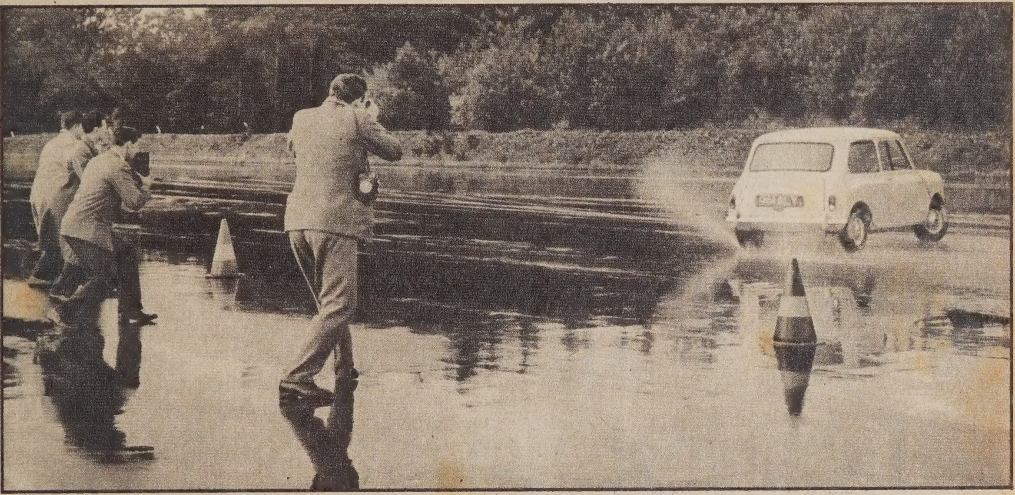
HIGHWAY RESEARCH IN BRITAIN

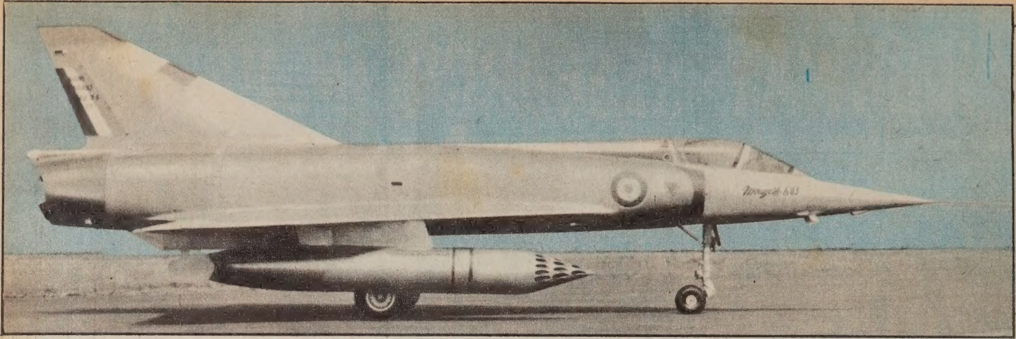


Constant research is necessary to establish the right relationship between the increasing speed and quantity of motor traffic and highway engineering. At Crowthorne, Berkshire, England, a new research track has been constructed, representing the first part of a £500,000 project, which will centralise the entire activities of the Road Research Laboratory of Britain's Department of Scientific and Industrial Research.

The 3-mile figure-of-8 track, contains a variety of road surfaces and a high speed section on which 100 m.p.h. can be attained. A built-in watering system facilitates observation of skidding tendencies on wet surfaces.

The picture above shows an Austin 7 vehicle skidding with all four wheels locked, as might occur due to sudden braking. Such tests establish how loss of steering and control can occur, with different orders of braking effective on different wheels.

The unusual vehicle below is a Citroen car to which has been fitted a fifth wheel, plus a variety of internal recording equipment. By dragging this wheel partially sideways, when the vehicle is moving forward normally, the skidding resistance of various treads and road surfaces can be plotted on a moving paper strip. The vehicle can be used on the special test track shown above but, for tests on open highways, a built-in tank allows the track ahead of the test wheel to be watered.



A side view of the Dassault Mirage III shows its clean, tapered lines and the tricycle undercarriage. Slung beneath the wing is the combined rocket launcher/fuel tank. Provision is made to carry one such launcher under each wing and one beneath the fuselage.

Mirage III Fighter —Technical Details

The Federal Government recently announced its intention of equipping the Royal Australian Air Force with the French-designed "Mirage III" fighter. The following article gives details of this versatile, new, high-performance aircraft.

FOR many years, the Royal Australian Air Force has been using the Avon Sabre as its front-line fighter, but it is now obsolete in this role.

Before selecting the Mirage III to succeed the Avon Sabre, a committee of experts surveyed all likely aircraft in production or under development, with a view to selecting one which would be best suited to Australia's defence needs.

While high performance was essential the plane had to have as large an operating range as possible, it had to be adaptable to a variety of defence roles and be able to operate, if need be, from makeshift bases.

Ultimately the choice narrowed to the American Starfighter and the French Dassault Mirage III, and, while many expected the Government, as a matter of policy, to favour the American design, their choice has ultimately fallen to the Mirage.

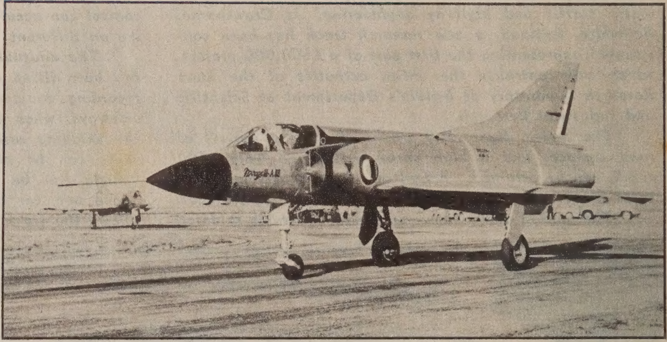
SWISS AIR FORCE

It is interesting to note that the Swiss Government also decided recently to standardise on the Mirage, largely because of its proven ability to manoeuvre in deep mountain valleys and to operate from poorly prepared airfields.

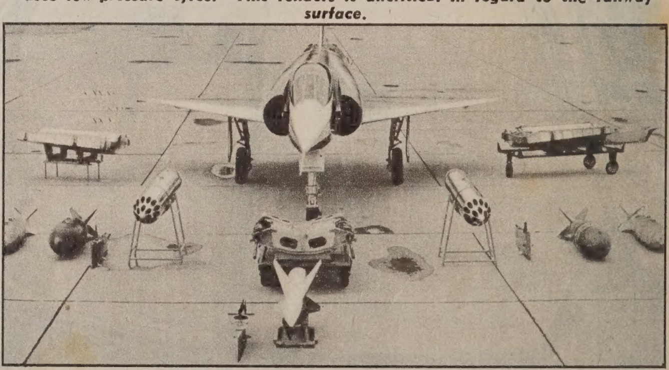
While the first group of planes for the R.A.A.F. is likely to be mainly of French manufacture, present intention is to set up local production. There has even been talk of manufacturing for export to other countries in the south-east Asian area.

By thus boosting the numbers produced, tooling costs would be spread, and the cost per unit plane considerably reduced.

The prototype of the present Mirage III made its first flight on November 18, 1956. Since then, the design has been refined aerodynamically and in regard to propulsion arrangements.



The Mirage III is unique among top performance fighters, in that it uses low-pressure tyres. This renders it uncritical in regard to the runway surface.



This front view of the plane emphasises the comparatively narrow wing span relative to the fuselage. Lined up in front and at the sides are the various equipment "packs" which can be installed within the fuselage or slung beneath fuselage and wings. Adaptation of the plane for different missions can be done speedily and simply on the airfield.

The prototype was followed by a pre-production batch of ten aircraft, the first of which started its test flights in May, 1958. These pre-production aircraft explored all flying characteristics, under operational conditions, up to speeds exceeding Mach 2 and at altitudes of over 70,000 feet.

More than 60 flights were performed using the supplementary rocket engine.

As a result of all these tests, specifications were set for a definite standard Mirage III. This was followed, in November, 1959, by a two-seat trainer version.

The French Government subscribed the initial contract for 40 Mirage III's, the first of which are currently going into service with the French Air Force.

From the very outset, design of the Mirage has been directed toward attaining the greatest possible versatility in service. The plane is eminently suitable for air interception, for tactical support, ground attack, long-range bombing and photographic reconnaissance.

EQUIPMENT PACKS

The versatility is due, in large measure, to the provision for interchangeable "packs" in the fuselage and beneath the short delta wings.

Thus, the pointed nose cone may contain a variety of radar or photographic equipment.

Within the fuselage, just aft of the cockit, is space which can be occupied by additional electronic gear, by a cannon pack or by extra fuel tankage, which can serve either the main turbo jet or the rocket motor.

Also within the fuselage, but below the tall tail fin, is space for still more fuel or a self-contained rocket boost engine, the latter to provide boost at take-off or to increase acceleration during air combat.

A great variety of equipment can be slung as desired, externally beneath the wings and fuselage. These include: Drop tanks of various capacities; 1,000lb conventional bombs; Napalm tanks; air-to-air missile; air-to-ground missile; sidewinder missile; combined rocket launcher/fuel tanks.

These equipments can be mixed in various combinations, so that the aircraft can be "set up" to best advantage for different types of mission, and can use a mixture of attack missile on that mission.

SPEEDY CONVERSION

Time involved in modifying the aircraft from one mission to another is claimed not to exceed one hour, in the most complex case, and is capable of being performed on the airfield itself, with only minor tooling requirements.

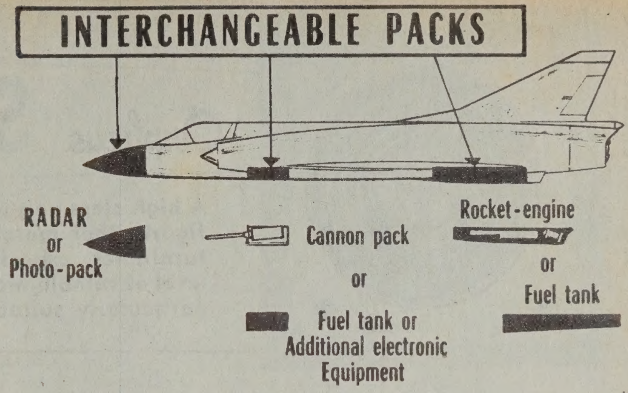
Dimensions and silhouette of the Mirage III are shown on the accompanying sketches.

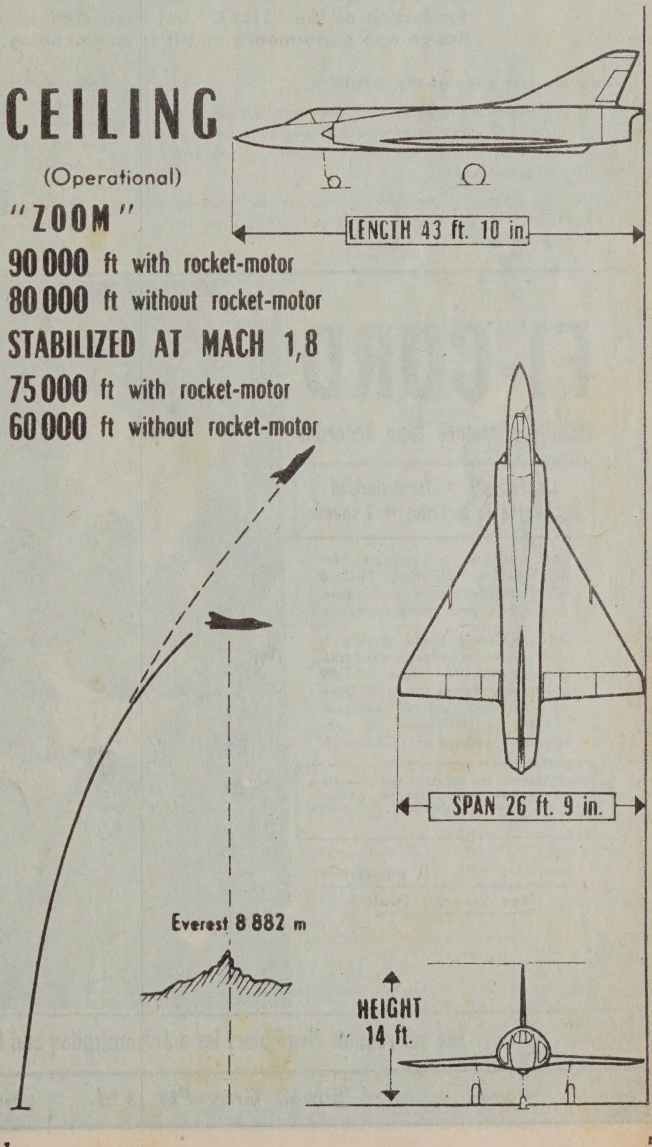
The original French version, as shown, is equipped with an Avon Mark 67 turbojet rated at 12,500lb static thrust and 16,000lb with reheat. The rocket unit motor, which can be accommodated for special missions, gives an additional 3,300lb of thrust.

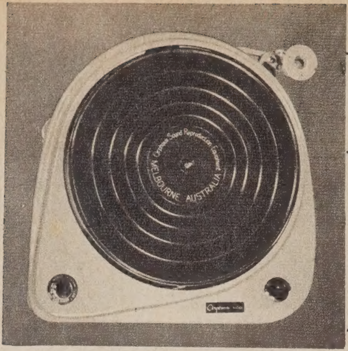
Official performance figures are as follow:

SPEED: Level flight, jet engine only, Mach 2.05.

ACCELERATION: From Mach 1 to Mach 2, with missile and without rocket


INTERCHANGEABLE PACKS
RADAR
or
Photo-pack
Cannon pack
or
Fuel tank or
Additional electronic
Equipment
Rocket-engine
or
Fuel tank


CEILING
(Operational)
"ZOOM"
90 000 ft with rocket-motor
80 000 ft without rocket-motor
STABILIZED AT MACH 1,8
75 000 ft with rocket-motor
60 000 ft without rocket-motor
Everest 8 882 m
LENGTH 43 ft. 10 in.
SPAN 26 ft. 9 in.
HEIGHT
14 ft.



Orpheus SILEX ... the perfect turntable

A high class unit with professional performance figures that match the world's most expensive turntables, especially with regard to the low level of rumble, wow, and flutter. This makes it particularly suitable for stereo work.

Production of the "SILEX" has been stepped up, as this model is ahead in design and performance and it is commanding attention everywhere.

Here are just a few of the details.

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And Fi-Cord's sound quality is well up to broadcast standards. Photo at left shows GTV-9 personality Panda using Fi-Cord to interview actress Maureen O'Hara in Hollywood for subsequent broadcast over Channel 9.

FI-CORD is the world's only miniature tape recorder priced for the domestic market, yet precision-built for professional use.

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CLIMBING TIME: Operational, without rocket motor, 50,000ft Mach 1.8 in 5.7min. With rocket motor, 60,000ft, Mach 1.8 in 5.1 min.

RADIUS OF ACTION: Altitude bombing, reconnaissance, 980 max. nautical miles; ground attack, high altitude approach 860 max. nautical miles, plus five minutes of combat manoeuvres; ground attack, low altitude approach, 430 max. nautical miles, plus 5 minutes of combat manoeuvres.

RUNWAY REQUIREMENTS: 3,900 to 4,900 feet (compared with 7,000 to 8,000 feet for other comparable aircraft).

TAKE OFF RUNS: 1,600 to 1,800 feet as interceptor; 3,000 to 3,600 feet equipped for long-range, tactical support, etc.

LANDING RUNS: 2,100 approx. feet with parachute brake; 4,200 approx. feet without parachute brake.

The Mirage III is equipped with electro-hydraulic dual-body servo controls, fed by two separate systems and three separate power supplies. They can be actuated directly or through a simplified auto pilot.

An ejection seat, operating upwards, provides a good safety factor for the pilot, even operating from ground level.

An air data computer and gyro centre measure and correlate all information required for flight and for weapon control.

Electronic equipment includes a VHF and UHF communications system, and a self-contained radio navigation system which is independent of ground installations. In addition, where special requirements apply, Doppler and Tacan can be fitted.

The radar equipment, installed in the nose, is designed to be readily interchangeable, and can be optimised for such functions as ground mapping, terrain clearance, search, lock and automatic tracking of the aircraft, target range measurement, bombing computation.

It is claimed that pilots trained on conventional Mach 1 aircraft can transfer without difficulty to the Mirage III.

MIRAGE IV

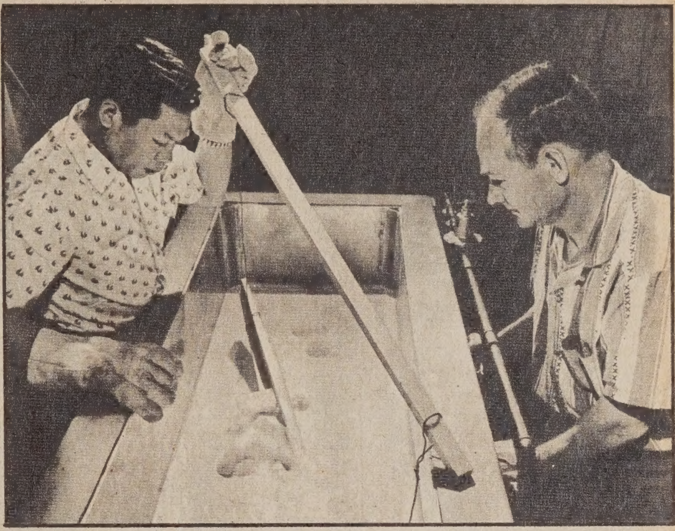
Recent tests with a prototype Mirage IV have indicated that the basic design has by no means reached its limit, as indicated by the standardised Mirage III.

Flying a circular course of 502 kilometres (311 miles) the Mirage IV bettered the as yet unofficial figure set by the McDonnell "Phantom" II for this distance, then went on to create a new record for 1,000 kilometres.

During this flight, the Mirage IV maintained an average speed of Mach 2.1, representing 1,222.64 m.p.h. at the operating height. The figure is claimed to be specifically significant because few comparable aircraft have been able to carry enough fuel within the fuselage to sustain such a distance, while many would also have suffered from internal heating problems.

In fact, performance of the Mirage IV was verified over the distance by radar control, while the cabin temperature stabilised at 71.6 degrees Fahrenheit.

NEW HEAT TREATMENT SYSTEM



Since the day someone discovered that iron would get much harder if plunged into water when red hot, men have been heating and cooling metals to get the most out of them. And since that day, the science of heat-treating has had problems.

ONE of the chief difficulties has been in achieving uniform, rapid heating and cooling. Heat and cold, the essential elements involved, must be completely and carefully controlled to bring out the desirable properties in airframe parts designed for hypersonic and space flight.

Manfacturing development engineers Charles Bennett and Charles Jung at the Boeing Aero-Space Division in Seattle have a new solution to the problem of rapid, uniform heating and cooling. They have devised a fluidised bed heat-treat furnace and quenching system.

Fluidised beds are not new in industry by about 15 years. They are used to "roast" pyritic ores in the production of sulphur dioxide and as catalytic cracking equipment for petroleum products. The Boeing development is the first known application of the fluidised bed to production heat-treating.

The Boeing fluidised bed, heart of the new system, forms the floor of the furnace chamber. The bed consists of a deep layer of tiny refractory particles, precise in shape and variations of sizes, resting on a diffusion plate. The bed looks somewhat like a child's sand box.

In operation, a stream of air or inert gas is directed up through the diffusion plate and into the bed under pressure equal to or slightly greater than the total weight of the particles. The mass of particles is buoyed and kept in suspension.

Thus expanded, the bed bubbles and swirls like boiling water. It is this fluid-like turbulence that provides rapid, uniform distribution of heat or cold—and gives the system its name.

Details of the bed's composition and the type of heat and refrigeration used are proprietary at this time. The secret of the bed's success, however, lies in its high thermal conductivity due to the violent random movement of the particles.

The fluidised bed has other advantages. Airframe parts, suspended in the churning turbulence during heat treatment, emerge free from unwanted adhesion of particles. Choice of air or any of a number of inert gases to fluidise the bed makes possible a variety of heat-treating techniques.

The new system encompasses temperature extremes needed to develop ultimate strengths and other properties in metals for current and advanced airframe designs. Heat-treating ultra-hard, thermal-resistant materials—heat - treatable steels, cobalt and nickel-base alloys or refractory metals — involves temperatures above 2,000 degrees F. to below —110 degrees.

The new system meets these temperature requirements.

Quenching is one of the more delicate phases of heat-treating, in which hot metal is suddenly cooled during the hardening process. The fluidised bed system is equal or superior to conventional water or oil baths. A small metal specimen, heated to 1,600 degrees F., was cooled to about 200 degrees in five seconds — an unusually high quenching speed.

This speed in quenching is due in part to the absence of what is known to heat-treating specialists as the "vapour phase" normally encountered in liquid quenching. A wall of heat-generated vapour forms around the surface of a hot part when first plunged into a liquid bath, preventing immediate contact with the quenching liquid.

The fluidised bed heat-treat furnaces now in operation by Boeing are relatively small, to meet specific needs. Engineers see no limitation to the size of furnaces which may be built in the future.

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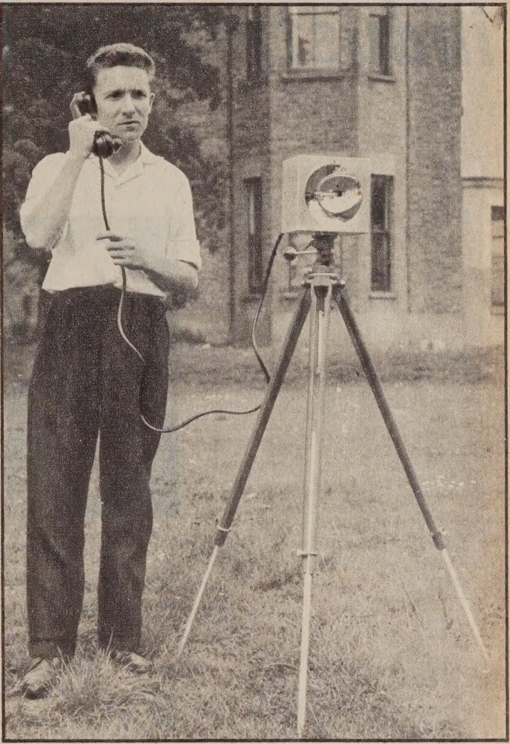
"MAKING LIGHT" OF VITAL DATA

RESEARCH CONTINUES INTO PHOTO-TELEPHONES

According to the writer, the "talking light beam" which has long been a scientific toy, is about to find its place as an accepted medium of communication. Over short distances, it has important advantages over the usual "Walkie-Talkie" type of radio apparatus.

By C. M. CADE



An infra-red photophone in use. The instrument, which is less than eight inches cube, has a frequency response good enough for the transmission and reception of high-quality music. It has been developed by Kelvin and Hughes Ltd., Dagenham, Essex, England.

THERE seems to be a popular misconception that the photophone — an instrument for "talking over a beam of light"—is a recent invention, due mainly to German scientists in World War II. Another misconception is that the heliograph—an instrument for signalling by means of reflected sunlight—is an invention due to the ancient Greeks. In fact, it appears that these two forms of communication are of roughly the same age (about 80 years), and that both are British inventions.

DEVELOPED BY GERMANS

The photophone was certainly brought to a high degree of effectiveness by the Germans. Their Lichtsprecher 250/130 had an average clear weather range of about eight and a half miles, and they exploited the advantages of the apparatus to the full. However, the first published work on the subject was by Alexander Graham Bell, and it antedated World War II by some 60 years.

In 1881 Bell published a paper with the title, "On the Production and Reproduction of Sound by Light." In this paper Bell described his experiments with "upwards of 50 forms of apparatus for varying a beam of light in the manner required," but he also states that "to Mr A. C. Brown, of London, is undoubtedly due the honour of having distinctly and independently formulated the conception and of having devised apparatus, though of a crude nature, for carrying it into execution."

Brown's invention preceded that of Bell by about two years, and was made only two years after Bell's invention of the telephone itself (1876). The photophone created great interest at the time. It was the subject of several papers read before the Royal Institution, and it led to further research all over the world. From 1880 until 1917, when T. W. Case introduced his "Thalofide" light-sensitive cell, all optical telephones depended upon another British invention—the selenium cell, due to Willoughby Smith, who discovered the photo-sensitivity of selenium in 1873.

NO RECORD OF CODE SYSTEM

To return briefly to the heliograph. Although it has been suggested that the Greeks at the Battle of Marathon (490 B.C.) might have signalled by means of flashes of sunlight reflected from their shields, there is no record of such a form of signalling having been known. Alexander the Great (356-323 B.C.) is known to have used a polished shield for flashing signals, and, although simple ideas could have been conveyed by some pre-arranged code of flashes, the transmission of detailed information would have necessitated an alphabetical code of some such form as that invented by Samuel Morse in 1831.

So far as is known, the heliograph was invented by Sir Henry Christopher Mance, and it was first successfully exploited in India in 1877-78, and by Lord Roberts during the second Afghan War (1879-1880).

There is no fundamental reason why radiation of any wavelength throughout the electromagnetic spectrum should not be used for communications. A beam of any radiation can be modulated in one of three ways—in frequency, in intensity, and in polarisation. A phototone transmitter is an instrument whereby noise vibrations are caused to modulate a beam of light in one of these three ways. A photophone receiver is an instrument which is sensitive to the modulated light and which produces a proportional electrical signal to operate a loudspeaker or telephone receiver.

All successful photophones to date have employed intensity modulation.

The effective range over which a system will work is dependent upon the power of the source, the beam angle, and the sensitivity of the receiver, while the frequency response or bandwidth (which determines the clarity of speech, and the possibility of transmitting information of more complicated forms, such as music, or television pictures) depends upon the "modulability" of the source and the response-time of the detector.

BANDWIDTH REQUIREMENTS

Distorted, but intelligible, speech can be conveyed with a bandwidth of a few hundred cycles per second. For the transmission of television pictures over a beam of light, the receiver must have a response time not greater than one-2,000,000th of a second, and the source must be capable of being modulated at a correspondingly high speed. Good quality musical reproduction is possible with a bandwidth of 9,000 cycles, but even this was far beyond the response of early selenium cells.

The Germans evolved the first really effective military photophones in World War I. These employed modulated carbon-arc lamps for the transmitter and selenium photoconductive cells for the receivers. They were rather large

OC35

industrial power transistor

Here is the OC35 — a new *power* transistor which supersedes the OC16 as a standard type for general use in industry. The OC35 is inexpensive and has a maximum current rating twice that of the OC16. It is well suited for use in a wide variety of industrial low frequency amplification and electro-mechanical applications, and in particular those equipments which are operated from a 12 volt supply.

With this new transistor, current gain is high and is well maintained up to high current levels — even at 6 amps the minimum large signal current gain is 20. The metal envelope is of the new standard *power* construction which saves space and provides efficient heat conduction to chassis or heat sink. The resulting low thermal resistance, together with the unusually high continuous junction temperature rating of 90°C for a germanium device, allows a maximum dissipation of 10 watts at a mounting base temperature of 75°C.

The data sheet on the OC35 gives detailed information to ensure satisfactory operation of the transistor in as many industrial circuits as possible.

Abridged data for Germanium Power Transistor OC35

V_{cb} max.	-60V
V_{ce} max. (cut-off)	-48V
V_{ce} max. (I_c =6A)	-32V
I_c max.	6.0A
p_{tot} max. (at mounting base temperature 45°C)	30W
T_j max. (continuous operation)	90°C
T_j max. (intermittent operation 200 hours max.)	100°C
$\bar{\alpha}'$ (at I_c = 1A)	25 to 75
$\bar{\alpha}'$ (at I_c = 6A)	20 to 45

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and clumsy, but had an average clear weather range of about five miles. The quality of the speech was poor, due to the difficulty of modulating the carbon-arc and to the inherent "noisiness" of the selenium cell.

A British system using an entirely different form of modulation (vibrating grids interposed in the beam of the lamp) was started at the instigation of Professor (later, Sir William) Bragg, then Scientific Adviser to the Admiralty. A range of about one and a half miles (2.5 kilometres) was obtained, both the range and the speech quality being limited, once again, by the noise factor of the selenium receiving cell.

The Americans were also active during 1914-1918, developing both plain speech and coded tone systems, but they did not produce successful apparatus until the end of World War I, when the Case "Thalofide" cell became available. A system developed by T. W. Case used, as source, an acetylene flame modulated by speaking into a horn which transmitted the voice vibrations to the gas inlet: the receiver was a "Thalofide" cell followed by a valve amplifier. Ranges of about two miles were obtained with twelve-inch mirrors for both transmitter and receiver, and could be extended to nearly five miles by using 24-inch mirrors.

ADVANCES IN TECHNOLOGY

In the interval between the wars, advances in technology generally made it possible for much better photo-telephones to be constructed but, although research in connection with the sound motion picture industry produced excellent vibrating ribbon-shutter and vibrating mirror voice modulation systems, the photo-telephone remained a scientific curiosity, to be brought out at exhibitions, but not to be put to serious work.

During World War II the Germans had an undoubted lead in the field of applied infra-red technology, principally because of their considerable advances with sensitive, low-noise detectors. The Lichtsprecher series of vibrating mirror systems used tungsten filament lamps as the source and lead sulphide cells as the detectors. The range performance was excellent, but the speech quality was still rather poor because of the inefficiency of the modulation at the higher speech frequencies.

The Japanese systems also used vibrating mirrors for modulation and a set of filters was provided so that white, yellow, red or infra-red light could be selected, the source of radiation being a tungsten filament lamp. The average clear weather range at night was about one and a half miles (2.5 kilometres).

One of the most striking wartime innovations was the use by the Italians of tungsten filament lamps in which the filament current itself was modulated. This is possibly the simplest and easiest form of modulated source to produce, but it is difficult to get adequate modulation depth, and this falls off progressively at higher frequencies due to the thermal inertia of the filament.

American developments were numerous and, as in World War I, they covered both plain speech and coded tone systems. Their chief original contribution was the development, by Westinghouse engineers, of the modulable caesium vapour lamp in 1944. This source provided much better frequency characteristics than any previously used, and with adequate power for ranges of several miles to be achieved with reflectors of moderate size.

FAST RESPONSE TIMES

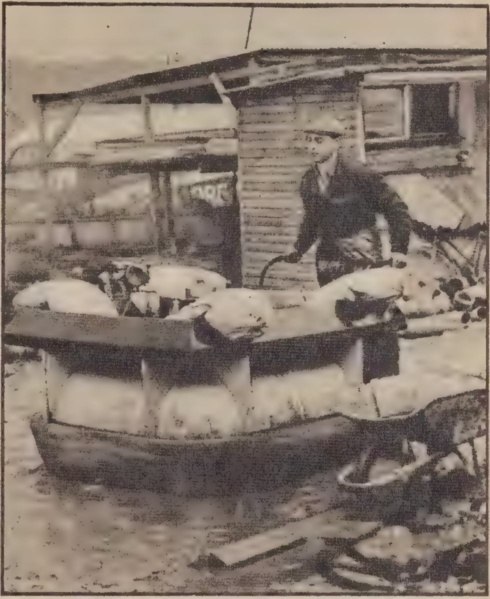
No new principles have been exploited in the 15 years since World War II ended, but continuous improvements in detail and the development of detectors with extremely fast response times has made it possible to obtain ranges as good as those given by military equipments, but with much simpler apparatus and with greatly improved frequency response.

Most of the advances in high-speed detectors for the near and intermediate infra-red spectrum have been made by the United Kingdom Government Research Establishments. More recently, the Americans have made quite spectacular improvements in the performance of detectors for the far infra-red.

High-intensity cathode ray tube sources, in combination with the high-speed detectors, now make possible not only transmission of speech of perfect clarity, but also the transmission of undistorted music, and even of the complex frequency patterns which make up a television picture.

However, it is less in the technology of systems than in the applications that the greatest advances have been made. In the last year or two there has arisen a commercial and industrial interest in this invention which has for so long been confined to military uses. The first intended use of the compact walkie-talkie radio transceivers was to enable a fire chief to talk to his men at the top of their ladders, a function which can now be served more conveniently by an infra-red photophone of perhaps one-quarter the size and weight of a radio transceiver, and with the further advantage that there can be no unwanted cross-talk between links.

THE "HOVERBARROW!"



If we didn't have a picture to prove it, you'd probably not believe that someone has, in fact, produced a "Hoverbarrow" to replace the old faithful seen on the right. But why? Builder Ted Drewery says that the conventional barrow is almost useless in the morass of mud which covers many building sites. The Hoverbarrow, riding a cushion of air, rides over mud, potholes and rubble without effort, though the strip of canvas around the bottom does save mud and water being blown in all directions as it passes!

Other situations where optical or infra-red links offer every advantage are, for example: between surveyors in the field; between signal-box and shunters in marshalling yards; between ships at sea, in place of signal lamps or flags; ship-to shore when entering or leaving harbour; between fishing fleet vessels to convey private information concerning fish location; between site foreman and operators of cranes, bulldozers, or other machines with a high ambient noise level; between Dock Master and cranes or tugs; between Control Tower and aircraft on the runway; fixed installations between buildings for private use; Civil Defence communications; down and along mine shafts—especially in emergencies; and for temporary audio-frequency links in connection with outside broadcasts, especially in disaster areas.

Recently, a firm in Britain has given some thought to the economic aspects of optical communication links. Wartime equipments were too large and clumsy, and designed with too little thought for cost, to be readily adaptable for civil use.

The problem has been solved with a lightweight photo-telephone, having its own power supplies in a box of less than eight inches cube. Frequency response is good enough to permit the transmission and reception of high-quality music. The range of the equipment as illustrated is about 800 yards but it may be more than doubled by the use of larger mirrors.

Perhaps the invention of Mr A. C. Brown, of London, after 80 years, is on its way to achieve the widespread use predicted for it by Alexander Graham Bell.

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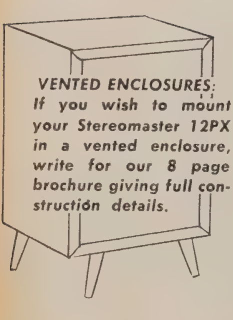

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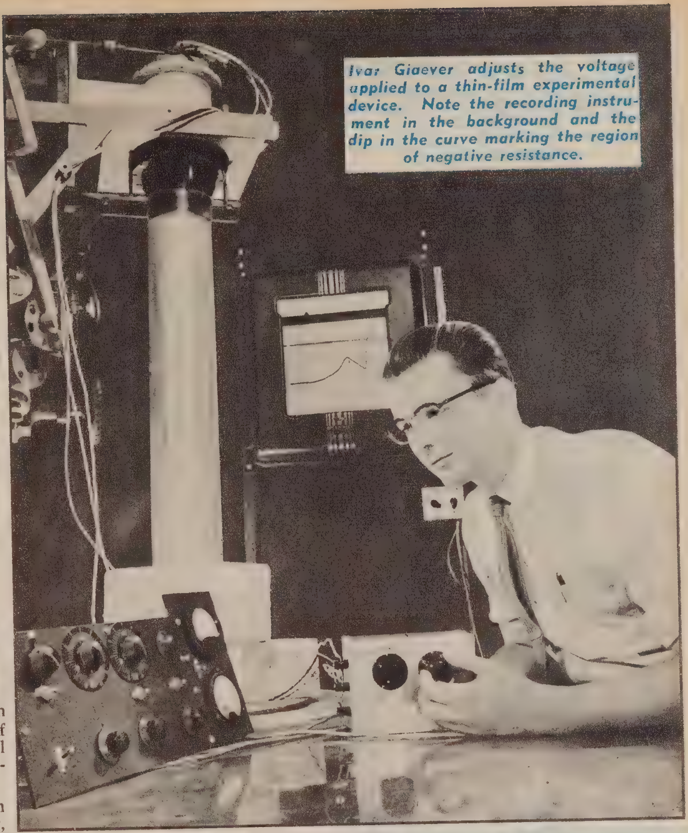
RE5

New Electron Tunnelling Phenomena



Ivar Giaever adjusts the voltage applied to a thin-film experimental device. Note the recording instrument in the background and the dip in the curve marking the region of negative resistance.

A new discovery, relating to "tunnelling" phenomena, has recently been announced by the General Electric Company. It yields new scientific concepts and may open the way to a whole new family of electronic devices. The following explanation is based on an article by Ivar Giaever, who first observed the phenomena.

I THINK it would be helpful to begin this explanation by reminding you of the difference between good electrical conductors such as metals, and good electrical insulators such as plastics.

Both metals and plastics contain an enormous number of electrons. However, in a metal, a significant part of these electrons can move about rather freely within the total volume while, in an insulator, the electrons do not wander from atom to atom. We should also remember that electrons are regarded as fundamental particles, and that all electrons carry a fixed amount of electrical charge.

If a small electrical potential difference, or voltage, is applied between the ends of, say, a copper wire, the electrons in the copper will tend to flow through the wire to equalise the applied potential or voltage. This electron flow is referred to as electric current.

If we apply a voltage difference across an insulator the electrons will want to flow but, by the very nature of the insulator, they are prevented from flowing.

PERFECT INSULATOR

A vacuum may be regarded as a perfect insulator, since it contains no electrons at all. We also have perfect conductors, which we call "super-conductors."

The superconducting state is achieved by bringing certain metals down to very low temperatures. For example, if a ring of lead is kept at the extremely low temperature of 4 degrees K (about 500 degrees below zero on the Fahrenheit scale), current induced in it will continue to flow forever. Other metals which have this fascinating property of super-conductivity are tin, below 3.7 degrees K; indium, below 3.3 degrees K; and aluminium, below 1.2 degrees K.

Another important fact about the superconducting state is that a magnetic field will influence the superconducting properties of a metal, and no metal is known to be superconductive in a high magnetic field.

Scientists have long been intrigued and puzzled by superconductive properties. Only relatively recently has a quantum mechanical theory of super-conductivity been developed by Bardeen, Cooper and Schiefer at the University of Illinois.

ELECTRON ENERGY

In all theories of conductivity a property of vital importance is the absolute energy of the electrons and how many electrons we have per unit energy range. We speak of this as the electron density of states. The tunnelling experiment I shall describe is ideally suited to measure the density of states in a super-conductor and it represents an entirely new approach to the problem.

The experiment is basically extremely simple. Let us separate two metals by an insulating layer which is very thin, say only 10 atom layers, or approximately 1/10,000,000 of an inch thick.

This sounds like a difficult task, but it

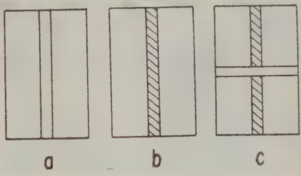


***Figure 1:** Preparation of the device. (a) Aluminium evaporated on glass slide; (b) The strip is oxidised. (c) Strip of lead evaporated across the aluminium strip, sandwiching the oxide film between the two metal strips.*

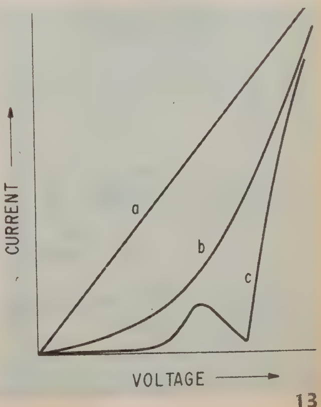


***Figure 2 (right):** Characteristics for tunnelling through a thin insulating film. (a) Between two normal metals; (b) One normal metal and a superconductor; (c) Two superconductors, showing negative resistance.*

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may be accomplished in the following way: First we evaporate or vapor deposit a strip or film of aluminium on a glass slide, as shown in Figure 1a. We then expose this aluminium film to air for a few minutes, permitting a very thin natural oxide layer to form on the surface of the aluminium film (Figure 1b).

Finally we evaporate a lead film across the aluminium film. This sandwiches the aluminium oxide layer between the two metal films, as shown in Figure 1c.

If a potential difference, or voltage, is applied between the two metal films, a current will flow through the insulating layer! In other words, even if two metals are completely separated by an insulator, they are not electrically insulated from each other, as long as the separation distance is small.

In quantum mechanics one would say that the electrons "tunnel through" the insulator. In more ordinary language one could say that a current flows through the insulator, because a number of electrons large enough to be measured as electric current pass from one metal to the other.

APPLIED POTENTIAL

In Figure 2 we show how this current depends upon the applied potential. Curve "a" illustrates tunnelling between two metals (in this case tunnelling between lead and aluminium through aluminium oxide) when the temperature is at say 10 degrees K. At this temperature neither lead nor aluminium is superconducting. We see that in this situation the current is directly proportional to the voltage.

Curve "b" illustrates tunnelling between a normal metal and a superconductor. At low voltages, almost no current flows. The superconductor does not accept electrons with such small energy. We observe this behaviour for our aluminium-aluminium oxide-lead sandwich at temperatures between 1.2 degrees K and 7.2 degrees K, where only the lead is superconducting.

Finally, curve "c" shows tunnelling between two superconductors; we achieve this by cooling the aluminium-aluminium oxide-lead sandwich to below 1.2 degrees K, where both the lead and the aluminium are superconducting.

NO CURRENT FLOWS

In this situation, the first part of curve "c" shows that, when the voltage is low, almost no current flows. This is because electrons with small energies are reflected from a superconductor.

Then, as the voltage increases, the current also increases. But after a certain voltage has been reached, the current decreases as the voltage increases. Finally, in the last part of this curve, we see that the current increases with the voltage once again and approaches the normal value.

The difference between these curves tells us how the important property — the electronic density of state—changes when a metal becomes a superconductor. We have also provided a simple means to observe and therefore, hopefully, to understand the effects of temperature variations and the effects of magnetic fields upon superconductors.

Though at present this discovery is primarily of scientific interest, it seems possible that it may yield a variety of practical applications, particularly because of the negative resistance region and because of the extremely low power requirements of each element.

Referring to Figure 2 again, we see that quite different current-voltage characteristics can be obtained from the "sandwich" by varying the temperature.

Recalling the ability of a magnetic field to return a superconducting metal to its normal state, we readily see how entirely similar current-voltage variations could be obtained by subjecting the sandwich to a magnetic field.

By varying a magnetic field, one or both of the superconducting films can be changed to the normal state, with a consequent change in operating characteristics of the device. This is why it may be possible for it to function as a switch, diode, negative-resistance diode, triode, resistor or capacitor.

It has been found, for example, that at 0.2 millivolts the current through a lead-aluminium oxide-aluminium sandwich at 1 degree K changes by a factor of 100,000 between lead in the superconducting and in the normal state!

With regard to the negative resistance effect, the sandwich is unique in that this important effect is independent of the direction in which the current flows through the device. This versatility is not possessed by the tunnel diode.

LIKELY ADVANTAGES

Potential advantages of devices based on the new effect would be extremely small size, low power requirements, and cheapness of fabrication. Since the devices would be made simply by depositing metal and insulating layers on a suitable substrate, it would be possible to deposit complex circuits involving hundreds of active components in one operation.

This would result in a very large reduction in cost from present methods of fabricating and assembling complex circuits, and would make possible a comparably large reduction in size.

The extremely low power dissipation —with only a small amount of heat generated—would make possible packing of the microminiature elements at a density many times greater than is possible with present semi-conductor components.

A great deal of applied research and development will be required to evolve practical devices based on this new concept. Also, the requirement of cryogenic temperatures for the suggested new components may be a handicap, but this is not expected to be too serious for many uses.

Small liquid helium refrigerators are available, and the low power dissipation of the devices may make cooling requirements actually less critical than for large, compact arrays of present components.

SPECIAL CIROUITRY

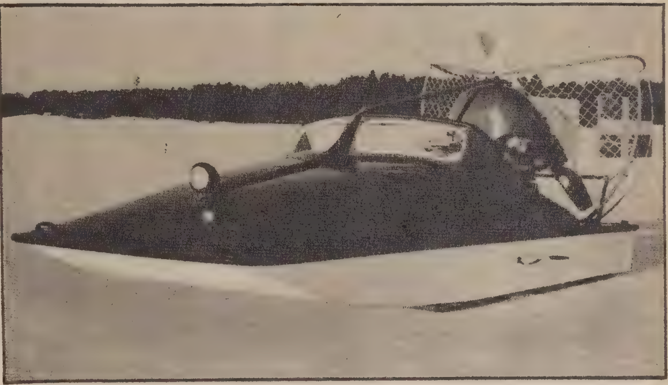
Since the current-voltage characteristics are unique, it seems plausible that the devices may require development of unique circuitry, rather than be used as substitutes for present devices.

Most of the experiments to date have been with films of aluminium, lead, indium and tin, all of which become superconductive at near liquid helium temperatures. A considerable number of other metals are expected to exhibit the same effect.

The discovery of these new, previously unsuspected effects will inevitably contribute to fundamental scientific knowledge of both superconductivity and tunnelling. One of the basic problems of superconductivity is why some materials are superconductors and others are not.

Solid state physicists will now find it necessary to develop the theory of electron tunnelling beyond the previous state of understanding—which was sufficient to explain tunnel diodes—in order to explain fully these new results.

SPEEDS ON WATER, SNOW OR ICE



This "Hydrocopter" is the most advanced vessel in a fleet of small craft, which is currently being operated by the Swedish Board Of Customs around the country's coastlines. The craft is made of glass fibre and is powered by a Volkswagen engine, developing 34hp. and fitted with a propeller. Speed on water is 18.5mph, 37mph on snow and over 60mph on ice.

If we had ears to hear, the sounds of the forest would take on a very different character. Birds, insects, foliage may all produce "sound" in the ultrasonic region.

Ultrasonics Here, There, Everywhere

Though references to ultrasonics date back for more than a century, it's only in comparatively recent times that ultrasonic phenomena have found wide practical application. And what application—everything from locating submarines to sterilising food, washing clothes and mixing "uncooperative" chemicals.

by Calvin Walters

THE science of ultrasonics is a study of the effects of "sound we cannot hear."

This definition is not strictly correct, of course, because the word "sound" is usually applied to wave motions of the air which have an audible effect upon our ears.

A more correct definition would be that the science of ultrasonics is the study of the mechanical vibrations, which lie in frequency above the limits of our hearing. But why use all those words where one will suffice? So, in this article the word sound will include all physical vibrations, both audible and inaudible.

THE EAR

The human ear is an organ which has to take more punishment than any other organ, with the possible exception of the stomach, which modern living abuses to a high degree.

The ear, however, is subjected to an overwhelming volume of noise produced by a wide variety of vehicular traffic, machinery, ear bashers, telephones, Elvis Presleys, rock-'n-roll bands, nagging wives, motor mowers and so on.

To be assailed by so much noise and still function efficiently is a measure of the remarkable stability of those remarkable organs — our ears.

Sounds, as we all know, are produced by vibrations or waves in the air which act upon our ear drums, setting in motion an astounding contraption of bones, chambers, liquids and nerves. These convey the vibrations to the brain where they are construed as audible sound, as we know it.

It is a little difficult at first to grasp the idea that sounds, as we hear them, do not occur in nature. What does occur is that something produces a wave motion of the air. It may be a falling tree, the movements of the vocal cord of a bird, animal or man, the wind in the leaves. Nothing but air movements are produced. It is only when an ear is present that these are converted into audible sound.

The human being can convert into audible sound all those air waves which vibrate from about twenty to twenty thousand times a second. Even these limits are governed by other factors, mostly age, so that many people cannot hear sounds above about 10,000 vibrations a second. We will refer to these vibrations from now on as the frequency.

The usually accepted range of audible sound is from 30 to 20,000 vibrations per second or a frequency of from 30 to 20,000 cycles per second.

There is a region below the lower limit which is called the subsonic region. The ear perceives sounds below this limit as a faint fluttering and is unable to determine the pitch of the sound. This is rather important to us for, if we were able to hear sounds below this, we would be driven insane by the sound of the beating of our own heart!

Above the upper region of audible sound we have the ultrasonic or supersonic region which is the region with which we are concerned here. This is the region of sounds we cannot hear but which are responsible for some astounding phenomena, which we now put to useful ends.

That there are sounds up there, which we cannot hear, but which are audible to some animals, birds and insects has been suspected for more than a century.

The first use seems to have been the design of a pecular whistle called the poacher's whistle. The "poacher," that criminal who sneaked into a neighbouring nobleman's domain and pinched a wild rabbit or something, used this whistle to round up dogs.

Who invented it is not clear. But upon blowing into the tube, all the dogs around the place came running, although the user of the whistle heard nothing. He probably didn't even know why the dogs came running! It was later found that the whistle produced an ultrasonic sound.

Many years later in 1883 a chappie named Galton invented what was known as "Galton's pipe" also to produce ultrasonic sound.

This pipe consisted of a solid cylinder mounted along the axis of a slightly larger hollow cylinder. This formed a cylindrical slit such that, when air was blown into the tube, it issued in the form of a thin-walled cylindrical jet. This produced sound just above the audible range of hearing.

MEASURING FREQUENCY

It might be asked how, at that time, the frequency of the vibration of Galton's whistle was determined. Another chappie named Kundt found that when sound is impinged on to a dust of cork filings in a glass tube, the filings arrange themselves into a pattern according to the frequency. By blowing Galton's pipe into the tube, a pattern was obtained, although no sound could be heard.

Later on, more refined pipes were investigated by more refined methods and the presence of ultrasonic vibrations became an acknowledged fact. Nothing much was done about it until the first World War when Professor P. Langevin of Paris invented the hydrophone for the detection of submarines under water. But more of this anon.

Ultrasonic sounds are produced fairly widely, in many accidental ways. The rubbing together by the wind of two branches of a tree can vibrate them fast enough to produce extremely high pitched sounds. Likewise the rubbing of any surfaces of machinery can do the same thing as also with the rubbing of rubber-soled shoes on a tiled floor. Even a squeaky door hinge will produce ultrasonic sounds in certain circumstances.

You have all noticed that if a squeaky door is opened slowly the hinge will produce a low pitched sound. The faster the door is opened, the higher becomes the pitch so that opening the door very quickly causes the two parts of the hinge to rub together at a speed which will eventually produce no sound at all. You haven't got rid of all the sound. You have only got rid of the audible sound and produced ultrasonic sound.

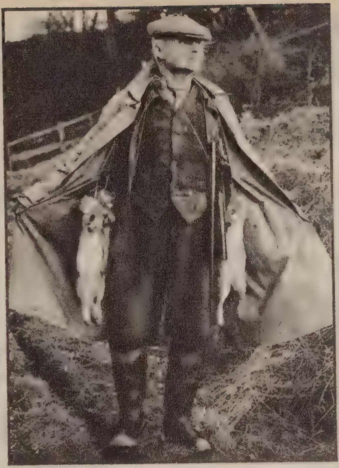
USEFUL TIP

Thus opening a squeaky door suddenly is an effective way of concealing your entrance when coming home in the early morning, after a night at the club. But first make sure that there are no umbrellas or coats hanging on the other side to bash against the wardrobe, otherwise your subterfuge will be of no practical value.

Many insects emit ultrasonic sound as their natural cry. Bats find their way by emitting ultrasonic sounds which are reflected from objects in their path of flight. Bats detect these reflections and are able to steer clear of obstructions in the darkness.

If an ultrasonic detector is placed in a forest there will be found to be present a veritable ultrasonic din. If our ears were not provided with an upper limit of audibility, sleep at night would be so much more difficult, because of the noise which would be present from all kinds of insects. Added to this would be all the ultrasonic sounds which have been found to accompany ordinary sounds such as the ticking of a clock, the sighing of the wind, the ringing of that modern curse, the telephone.

In 1880 Jacques and Pierre Curie discovered that certain crystals alter their lineal dimensions when subjected to the influence of an electrical field. Conversely when the crystal was subjected to mechanical stress electrical charges were developed on the surfaces of the crystal. This is called the "piezo-electric" effect.



You can be excused for wondering what a poacher has to do with ultrasonics. In fact, the poacher's whistle is probably the first recorded example of an ultrasonic device.

It is the principle upon which rests the functioning of the present-day crystal pickups for gramophones and the quartz oscillator as used in radio and television transmitters.

It was not until the year 1917, however, that anything was done about this discovery in the way of putting it to practical use. It remained a laboratory curiosity for all those years.

During World War I, when German submarines were causing havoc among Allied shipping, Professor P. Langevin of Paris used the piezo-electric effect to build an underwater detector called the hydrophone. This made use of the reflective property of sound.

It is well known that sound travels very well through water. Audible sound or sound waves of low frequency travel in all directions so that such a sound produced under water will be reflected from the front, rear and sides. It would be impossible to know from where the waves were reflected.

Langevin found that ultrasonic sounds could be transmitted in a narrow beam much the same way as light can be transmitted. The shorter the wavelength (or higher the frequency) the better it could be controlled.

In order to gain a large surface Langevin cemented a number of small quartz plates on to a plate in the form of a mosaic and clamped these between two large steel discs. The latter became the electrodes which vibrated when a voltage was applied to the quartz crystals and which, conversely, developed a voltage in the quartz when the plates were vibrated.

There being no other means to excite the plates, such as we have today with electronic circuits, Langevin used the electrical oscillations produced by a Poulsen arc, which were amplified in potential by an induction coil.

In accordance with the principle that waves of highest intensity are produced when a body is vibrated at its natural resonant frequency, Langevin applied the voltage at a frequency which coincided with the mechanical frequency of the plates.

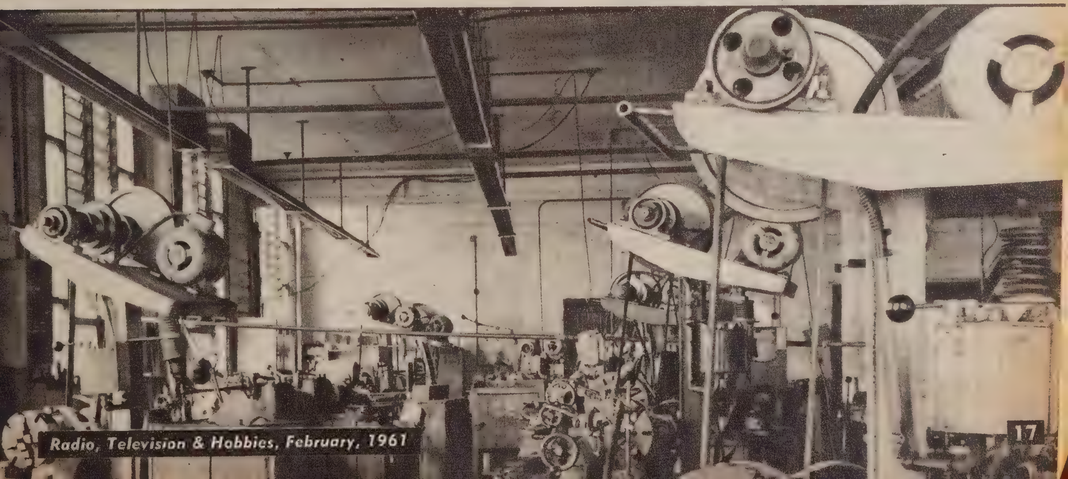
He thus not only produced ultrasonic sound at high intensity but became the first to use the resonant principle upon which the success of present-day ultrasonic devices depends.

IN USE

In practise, Langevin's hydrophone was placed in the water. One steel disc was enclosed in the container and the other in contact with the seawater. When vibrated the latter transmitted the ultrasonic sound in a narrow beam. After an interval this wave was reflected from whatever object it struck, say a submarine.

This reflected sound was received back on to the outer plate. The resulting vibrations caused current to flow in the quartz. By a suitable device these waves were detected, and by

Machinery can produce ultrasonic waves as well as the normal noise which we associate with it. In very high-speed devices, the ultrasonic energy can cause fatigue and even acute distress, without ever being heard.



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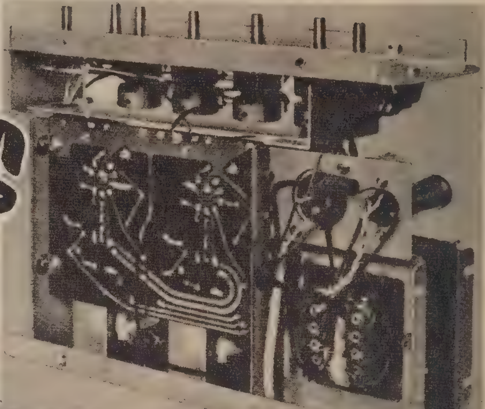

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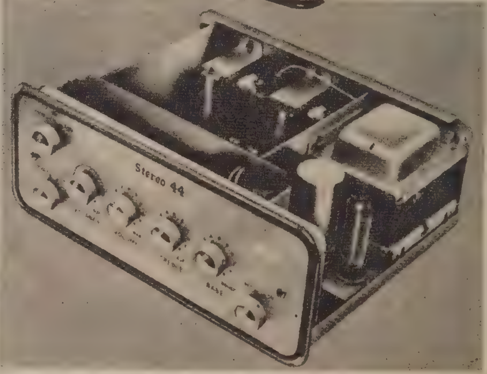

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measuring the time interval between transmission and reflection the distance of the object could be found.

Today, of course, this device has been considerably improved by the use of electronic tubes and circuits but the principle of resonance of quartz and other crystals is still the basis of the devices.

Ultrasonic sounds are now produced by two methods. Firstly there is the use of oscillating thin plates of quartz as described above or a new development in crystals, barium titanate. This chemical exhibits immense piezo-electric effects when used in the form of an impregnated ceramic. Quartz plates and barium titanate can be made to vibrate at speeds running into millions of vibrations a second thus producing "ultrasonic" sound of extremely high frequency.

In fact, the term ultrasonic becomes rather inadequate, though still accepted.

Another method used to produce ultrasonic sound of lower frequency makes use of a principle called magnetostriction.

MAGNETOSTRICTION

When certain metal alloys are subjected to the influence of a magnetic field, changes in dimensions of the metal take place. This effect is strong in alloys containing iron or nickel, and an alloy of 49 per cent iron, 49 per cent cobalt, and two per cent vanadium exhibits this property to a high degree.

Thus if a rod of suitable metal is wound round with insulated wire through which is passed an alternating current, which rises and falls in intensity, the rod of metal will be alternately magnetised and demagnetised. The rod will change its dimensions longitudinally in time with this applied current, and thus vibrate at the same frequency as the applied current.

If the alternating current is of high frequency so the rod will vibrate at the same frequency and emit ultrasonic sounds.

Depending on the thickness of the crystal plate or the length of the metal rod, ultrasonic sound waves can be generated at fantastically high frequencies. A wavelength of one metre will be generated at a frequency of about two million cycles per second. Even higher frequencies are being generated with modern apparatus.

When a crystal or rod is oscillating, the faces act like pistons which transmit the vibrations to solids, liquids or gases.

By suitable means it is possible to couple the crystal or rod generator to tanks of liquids in which some fantastic results are produced because of a process called "cavitation."

WAVE MOTION

Ultrasonic waves are a series of alternate compressions and rarefactions. When the crystal or rod expands it pushes the air or liquid ahead of it. When it contracts it draws the air or liquid downwards, but the first compression continues to influence all the air or liquid before it. As a consequence, the first compression continues to flow right through the medium to be quickly followed by others.

After each compression there is a rarefaction or sucking downwards of the medium so that these continual compressions and rarefactions give rise to violent agitation of the medium through which they pass. It is really the rarefactions which have the most violent effect and these may be so violent that the liquid is unable to withstand the tensions produced and is disintegrated.

BATTERY WATCH RUNS FOR YEAR

Manufactured by the Bulova Watch Co., this "Accutron" watch is powered by a 1.3 volt mercury cell, similar but not identical to those used in hearing aids. Housed beneath a cap in the rear of the case, the cell powers the watch for one year. A recessed control, also on the back of the case, allows the hands to be set.

When this disintegration occurs, millions of tiny bubbles appear which are filled with vapours and gases which comprise the liquid. This whole process is called cavitation, and is greater as the power of the ultrasonic sound increases.

The bubbles produced by cavitation last but a few moments before collapsing, but, during this time, astounding pressures are built up within the liquid. These pressures amount to several thousand atmospheres.

PRACTICAL USES

This type of apparatus has been put to some use in the sterilisation of water, milk and other foods. Under the action of cavitation, germs and other organisms are completely destroyed. The process has also been used to weaken the action of bacteria for vaccine preparation.

It is in the field of cleaning that this type of ultrasonic generator has had a wide application. It has, indeed, revolutionised the technique of removing grease, dirt and metal dust from such articles as ball-bearings, clocks, watches, vacuum tube elements, electric shavers, missiles, false teeth, all kinds of meters, gearboxes, motor parts and so on.

When the parts are immersed in a cleaning solution, which is subjected to ultrasonic vibrations, the violent agitation gets the solution into minute pores and spaces, which would be impossible to reach in any other circumstances. For cleaning it is not necessary to dismantle clocks, watches, gear-boxes and like apparatus.

In addition to the action of the cavitation bubbles, the process aids the chemical action of the cleaning fluid, so that it gets under the grease and dirt, leaving the metal cleaner than is possible by any other method.

Because ultrasonic sound penetrates most solids, it is possible to immerse containers holding different parts and different cleaning chemicals in the one ultrasonic tank. The vibrations penetrate the containers simultaneously, thus doing several jobs at once which formerly had to be done separately.

Because of this ability of ultrasonic sound to penetrate solids, generators have been used to detect flaws in metals. This procedure makes use of the principle of reflection.

THE REFLECTORSCOPE

Mention was made previously of the fact that it is possible to transmit ultrasonic waves in a narrow beam, as was done by Langevin and his hydrophone.

In the now standard instrument called the "reflectorscope" not only is the phenomenon of reflection utilised, but use is also made of the property of ultrasonic vibrations being transmitted in short bursts. This is not possible with low frequencies because such frequencies contain very few complete cycles, making it impossible to count the compressions and rarefactions in a given time interval.

The reflectoscope is used by pressing a vibrating quartz crystal against the metal surface to be examined for flaws or cracks.

A short burst of vibration is transmitted from the crystal in the form of a narrow beam. If there is a crack or flaw in the metal, the sound is reflected back to the surface, so that by measuring the time interval from the time of transmission to reflection or echo, it is possible to locate the crack.

If there are no flaws in the metal, the sound is reflected only when it reaches the opposite face. Such an apparatus is a vast improvement over the old method of tapping the metal with a hammer and listening.

Considerable research has enabled a scale to be constructed for varying frequencies and materials which enables the operator to gauge the depth at which a flaw occurs. In a similar fashion the instrument can be used as a thickness gauge.

With respect to the detection of flaws and defects, ultrasonic sound is more effective than the formerly used X-rays. The reason lies in the ability of ultrasonic sound to penetrate greater thicknesses and to reflect smaller defects.

X-RAY LIMITATIONS

X-rays can penetrate only about 12 inches of metal and are thus limited in application to comparatively small parts. X-rays and gamma rays can detect cracks not less than 5/32in wide. Ultrasonic sound on the other hand can penetrate considerable thicknesses and will lose power when impeded by the slightest flaw. This latter property is made use of in what is called a "through sounder" as distinct from a reflectorscope.

Here the crystal is applied to one face and the detector to the opposite face. Any variation in strength of the vibration against a known standard is thus immediately apparent and will indicate

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the presence of a flaw. A further application of the reflectoscope will thus locate the position of the flaw.

In the field of medicine ultrasonic sound is proving of benefit for the alleviation of certain maladies. For this, a special crystal is made to vibrate a metal plate, which is applied to the affected part of the body. By choosing the correct frequency the vibrations generate heat deep in the tissues, while the movement also provides a form of massage. It is thus useful for muscular and nerve pains.

FOR DIAGNOSIS

In diagnostic work, ultrasonics are finding increasing applications. By a system of "through" sounding as mentioned above in connection with metals, it is possible to detect the presence of tumours in the body. The type of echo reflected from a tumour is also different from that from a normal organ, so that with a type of reflectoscope the echo can be studied. It has been found that the character of the echo also gives a clue as to the type of tumour present.

In the washing of raw wool, it is usual to remove grease with an alkaline soapy solution. This tends to impair the qualities of the wool. By means of an ultrasonic vibrator wool can now be washed in a neutral solution in much less time.

An interesting new application of ultrasonics lies in the soldering of such metals as aluminium. Formerly this metal was difficult to solder because it is constantly coated with an oxide film which forms again immediately it is removed. It is, therefore, almost impossible to gain access to the metal with solder.

A new ultrasonic iron overcomes the difficulty. The copper tip of the iron is connected to a magnetostrictive rod vibrating at high frequency. The vibrations are conveyed through the tip to the metal to be soldered. The oxide film is thus completely torn away from the metal making it easy to solder with normal solders and fluxes.

SOMETHING TO SELL?

Why let those unwanted pieces of radio gear grow obsolete and useless on the shelf? You can turn them into ready cash through our "Wanted to Buy, Sell or Exchange" columns on page 128.

The destructive effects brought about by cavitation in an ultrasonically agitated liquid make it an ideal medium for the emulsification of dissimilar liquids. Cavitation reduces the particles to colloidal dimensions in a matter of seconds and thus emulsions are readily produced in a minimum of time.

Space does not permit more detail of other applications of ultrasonic sound. It is used for the control of the hardening of concrete. There is an ultrasonic microscope; it facilitates chemical changes and so on. There is no doubt that a bright future is in store for this astounding force and, because of the intense interest in research toward a greater understanding of ultrasonics, many new unexpected applications will be found.

Technical Review

RADIOACTIVE GAS CHECKS TRANSISTOR CASES

Leaks in the cases of transistors allow the ingress of water vapour and oxygen, both of which shorten the life of the transistor, and can result in an unexpected catastrophic failure. This article discusses limitations of current testing methods and describes a new system which promises a number of advantages.

At the moment one of the main methods of testing is to submit the devices to a humidity test and check the electrical characteristics for deterioration. The method is not foolproof, as temporary blockage of leaks can occur, which give misleading results. Search for minute leaks may take up to 70 days.

An alternative method, which is claimed to be quicker, subject to less error, non-destructive and suitable for large or small quantities, is testing by immersion in a radioactive gas.

The components to be tested are immersed in the gas and the latter raised to a known pressure for a fixed period. After removal from the gas, the amount inside the component is measured by means of a radiation counter. This will give an indication which is capable of interpretation directly as a leakage rate.

TRIAL SETUP

A laboratory-scale apparatus for this purpose is shown schematically in the diagram.

The transfer vessel containing activated charcoal in which the gas can be frozen is a means of transferring the gas to the pressure vessel. The techniques for building the equipment are well known and present no difficulties. The radioactive gas normally used is krypton 85, which is obtainable at a reasonable cost, approximately £10 per curie, but other activated materials may be used.

The rate of loss of gas is extremely small, 0.1 per cent per 1,000 operations. Provided the equipment is correctly installed and used there is no health hazard.

The method has a high claimed accuracy, it being easily possible to measure the radiation with a standard deviation less than 1 per cent. Times of immersion in the radioactive gas and pressure of immersion are selected to give the required radiation level for the rate of leakage expected.

Leakages as low as 10 to minus 9 cc/sec are easily checked, and it is possible with longer immersions to check several decades lower.

Tests on transistors have shown excellent correlation with results obtained on the two-day humidity tests. This is at a leakage rate of about 10 to minus 6 cc/sec. Leaks of 10 to minus 9 cc/sec do not show such a high correlation, the gas tests showing a considerably larger proportion of leaks than the short-term humidity test.

Extension of the humidity test to longer periods, up to 70 days, however, brings the results back into line with each other. This is explained by temporary blockages of the leaks occurring during humidity, or no contamination of the semiconductor material by the induced moisture. The longer test periods progressively increase the chances of either of these happening.

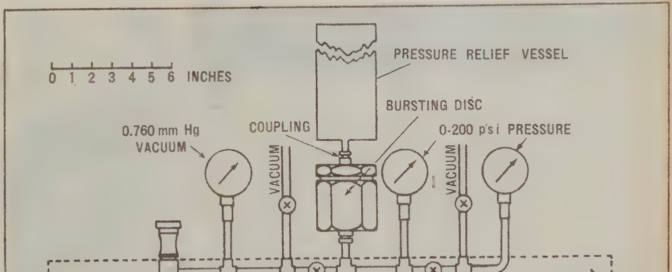
It has been found on sample batches of devices submitted to the UKAEA Wantage Laboratories, that approximately 10 per cent of the units tested have had leakage rates as high as 10 to minus 6 cc/sec. This applies to samples obtained directly from the production.

The technique is not suitable for detecting gross leakages, and these would need to be eliminated at an earlier stage in the testing. This, however, presents no problem, as in most cases simple visual checking will eliminate such units.

The use of the device is by no means restricted to the testing of transistors, but is suitable for any small sealed devices, or as a laboratory instrument for any group working on sealing problems. It will carry out many of the functions of a mass spectrometer at a considerably cheaper capital cost.

Saunders-Roe and Nuclear Enterprises Ltd. are preparing estimates on a commercial model of this device, or may offer a service using it.

(From "Electronics Weekly.")



A simplified diagram of the pressurising apparatus used for the leakage tests. It is claimed that extremely minute leaks may be detected by this system in a much shorter time than by other means. Equipment is comparatively simple.

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CAN AUSTRALIA EXPLOIT NATURAL GAS SUPPLIES?

In the search for oil in Australia one of the most promising fields has been the Roma district in Queensland. Oil has been produced, in small quantities, plus large quantities of petroleum based gas. Whereas previous efforts to exploit these reserves have failed, experts are confident that modern techniques can overcome the old problems. The latest scheme aims at developing the natural gas supply in commercial quantities.

Undoubted evidence of the presence of gas in the Roma district is this picture of a bore run wild. Ignition of the gas was accidental, several persons being badly burnt in the explosion.

THE discovery of natural gas in Australia in commercial quantities and at favourable locations would give a tremendous stimulus to the industrial and economic development which this country has been enjoying since the end of the war.

The most hopeful signs of success in the search for this important source of energy have recently been seen in the Roma district in south-east Queensland.

In other countries, the phenomenal growth since the war of the use of natural gas shows the great economic benefit that Australia would gain by the discovery and development of commercial gas fields.

OVERSEAS DEVELOPMENTS

In the United States, for example, natural gas supplies 27 per cent of total energy requirements. Canada is fast developing its vast natural gas resources and is even exporting supplies to the United States.

Other countries where the exploitation of natural gas has gone ahead rapidly in recent years include Pakistan, Japan, Italy, France, Algeria, Mexico, Venezuela and Argentina.

Consumption of natural gas in the western world has increased since 1951 by two-thirds, while in the same period, our consumption of oil has risen by little more than one-half. Last year total crude oil production was 831 million tons, while natural gas production was the equivalent of no less than 300 million tons of crude oil.

The United States provides the world's most outstanding example of the exploitation of natural gas reserves. Production and marketing of natural gas has developed in the United States until it is now the country's fifth largest industry, representing an investment of more than 21,500 million dollars. More than 99 per cent of the gas sold by American public utilities comes from natural sources, although manufactured gas predominated until 1944.

U.S. CONSUMPTION

Daily consumption of natural gas in the United States is about 30,000 million cu. ft., and the country has storage capacity for nearly 90 times that amount. On a much smaller scale the potential for development from the Roma field, if proven, is, nevertheless, enormous.

The possibilities of the discovery and exploitation of commercial gas fields in Australia have to some extent been overshadowed by the glamour associated with the search for oil. Tests to be made at Roma in the next year, however, may prove a commercial future for natural gas wells in that area.

Already there is talk of a pipeline likely to cost between £5 million and £10 million to supply gas from the Roma field to industrial and domestic consumers many miles away. It would sweep 300 miles through the rich and closely populated Darling Downs, down to the coalfields of West Moreton and Ipswich, and so on to Brisbane.

Cheap electricity produced from generators powered by natural gas could change the whole pattern of the future industrial development of Queensland, a State already rich in raw material.

One important agreement has already been reached. A test line will be built three and a half miles to Roma to pipe natural gas to the town's power station, where it will drive generators and produce half the electricity used in the town.

A decision to exploit the gas deposits could lead to the expansion of the power station at Roma to supply already established systems covering 90,000 square miles or more of the State.

Natural gas has been known to exist at Roma since the turn of the present century, but early attempts to develop it commercially failed. Latest tests follow the confirmation of an output of more than nine million cu. ft. a day of natural gas recently tapped from the Pickanjinnie well, 20 miles from the town, together with the Latemore, Timbury Hills and Hospital Hill wells in the area.

CONVENIENT MARKET

Nearly two-thirds of the people of Queensland live within a radius of 300 miles from Roma and the great bulk of the 2,000 producing factories of the State are already situated within that area. The heaviest concentration is, of course, in Brisbane, with its population of 600,000. But Toowoomba, central city of the Darling Downs, is less than 200 miles away.

If sufficient reserves of gas are proved, a major electricity supply could be developed to provide power for the Darling Downs and the Brisbane metropolitan areas, together with the Gold Coast tourist playground to the south and the northern parts of New South Wales.

There is little doubt that the Queensland Government would support planned development if commercial prospects of a major natural gas find were proven. Pending the outcome of tests at Roma, the Government has temporarily shelved a £60,000 report on future development of the State's electricity system by the use of traditional sources of energy, such as coal and water.

Roma gas might also prove, as it has in the U.S. and other countries, a major source of domestic gas. If supplies prove sufficient, natural gas from Roma could be supplied to a number of centres in south-east Queensland, including Brisbane, Ipswich and Toowoomba.

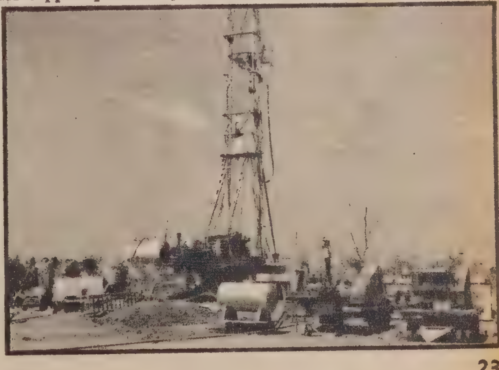
Piping natural gas 300 miles from Roma should not present great problems. Some of the main producers in the United States are 1,000 miles and 1,800 miles from their consuming areas. Indeed, the industry in the United States, plans a 3.455 million dollar pipeline construction program in the next four years.

For the forthcoming supply to the powerhouse at Roma, it is proposed to

☆

A drilling jig at Pickanjinnie well. Modern techniques promise to solve many problems which hampered development in the past. Many believe that both oil and gas will be found in useful quantities.

☆



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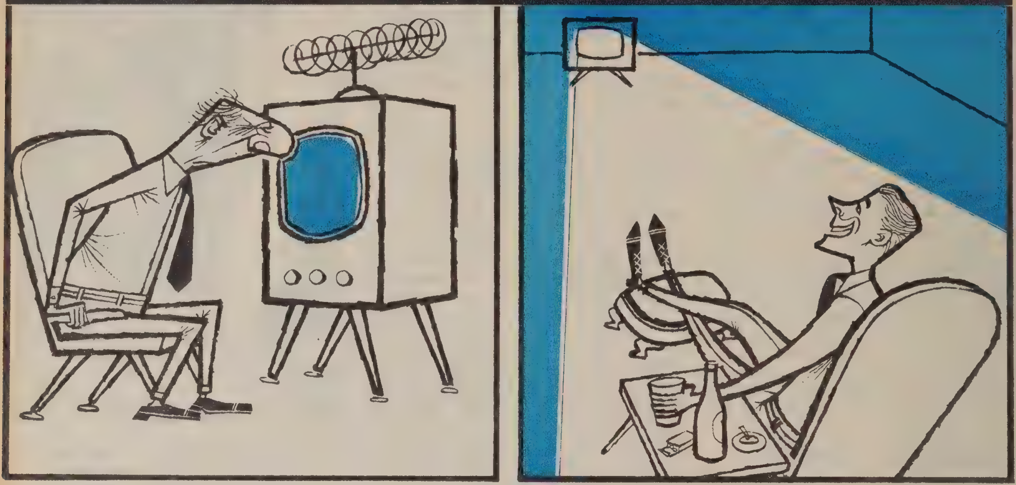

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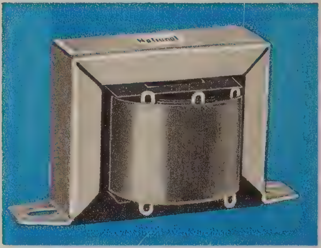

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feed up to 70,000 cu. ft. of gas a day in 2in and 3in pipelines from the Timbury Hills and Hospital Hill wells. This will be the first commercial use of natura gas in Australia.

It is proposed to supplement the two small existing generators which have a total capacity of 200 kilowatts, with a 500 k.w. plant moved from nearby Dalby for the experiment. The plant will initially supply electricity to half the town of Roma, which has a population of 5,000.

It is known that there are tremendous supplies of water underground at Roma. This would make possible the establishment of a major power plant, and apart from anything else could attract industry to the area.

LIKELY CONSUMERS

Within a 300-mile radius of Roma are the Mount Morgan copper mines, and proven reserves of many other minerals in Central Queensland which could well be developed profitably if cheaper power were available.

Within the circle there are already sugar mills at Nambour, Maryborough, and Bundaberg, a cement works near Brisbane, some of Australia's biggest timber mills in Brisbane and Maryborough, meat works at Gladstone and Rockhampton, machinery manufacturers at Dalby, major engineering works at Toowoomba, Brisbane, Maryborough, and Bundaberg, and shipbuilding yards at Brisbane and Maryborough.

Electricity is basic to all these industries, and if cheap electric energy were available, it would go a long way toward keeping production costs on a competitive basis.

Attempts to produce gas and oil from early wells in the Roma district were frustrated by the inability to isolate completely oil-producing sections from water-bearing formations. An attempt to supply Roma with gas in 1906 failed because percussion drilling, the technique then employed, caused the walls of the hole to collapse, thus letting water in, which cut off the gas flow. The hole was never cleaned out. Several wells in the area which showed oil and gas were not correctly evaluated because of water penetration; in addition, most of the dry wells previously drilled are known to have been "off structure."

MODERN TECHNIQUES

With modern drilling techniques, however, a zone can be isolated and tested during the progress of a well, and, on reaching total depth, casing is run and cemented so that the production zone or zones are protected from contamnation. Perforations are then made at the required places to allow production.

The largest of the wells in the Roma area, Pickanjinnie, has a confirmed output of 6½ million cu. ft. a day (this would be regarded as notable in the United States where new wells producing at that rate are rare), but calculated reserves of daily production rate over the next 20 years have not yet been announced.

The company, doubtless, intends to prove up much more of its area and to get nearer its minimal quantities before drilling and operations on well completion and testing are halted.

Pickanjinnie, in fact, provides Australia's biggest flow of natural gas. The wells at Latemore, Timbury Hills and Hospital Hill combined have an estimated flow of at least 2,850,000 cu. ft. a day.

The discovery and exploitation of large reserves of natural gas in Queensland would undoubtedly be followed by considerable economic development in the State, for the availability of cheap power supplies is a major factor in inducing industry to establish itself in a region.

Much of the planning and thinking is at present at a most preliminary stage, and in determining precisely how the natural gas deposits should be developed many factors—economic, technological and political—will have to be taken into account.

(From "Petroleum Gazette")

BRITISH COMPUTER-TRANSLATOR

One of the latest experiments in electronic language translation is currently being conducted by an English research team, who are concentrating on French-English translation, and vice versa. Efforts are being concentrated towards better "education" of the computer in order that the finished translation shall require minimum human correction.

DEVELOPMENT of the technique for this application has been the responsibility of a research team at Birkbeck College, headed by Dr. Andrew Booth, Britain's leading authority on machine translation of languages.

In an interview with Electronics Weekly, Dr. Booth said, "A rational translation of French into English, or vice versa, can now be obtained automatically by using electronic machines.

"The system is not 100 per cent foolproof, but I believe this to be impossible when dealing with a modern language which is in dynamic state and continuously developing. Vocabularies are constantly expanding and new constructions being sought."

Dr. Booth commented that the novel illustrates this point, particularly when writers are recording colloquialisms and local dialect.

Most of the studies at Birkbeck have been carried out on London University's Mercury computer. Material to be translated is converted into a binary code, punched on to paper tape and fed into the machine.

The computer program then guides the machine through the stages of automatic analysis.

Several thousand basic English constructions, words and phrases are held in the main store.

OPERATION

When a French text is fed in, the analytical elements of the machine parse each sentence. By a method of comparison, the equivalent English constructions are selected from the store.

This data is then held in a short-term memory, until the remainder of the sentence has been indexed in the dictionary part of the store. When the whole process has been completed, a translation is printed out.

One of the investigator's problems was how to eliminate possible ambiguities when a word has more than one meaning.

A not unlikely phrase might be, "She cannot bear children"; which could be interpreted either as to dislike, or as unable to give birth.

To determine the correct connotation, a check has been built into the computer program.

The dictionary records this particular phrase as having a social implication or a medical one. A section of the memory containing a subject reference acts as an arbitrator. If the material comes from a medical text-book, say, the appropriate context for the phrase is selected.

However, the subject of a book may well change. To detect this, the "arbitrator" incorporates a facility for learning and forgetting. Each sentence is analysed for subject by a subsidiary circuit. At regular intervals this auxiliary check is compared with a main reference store.

When a change of subject is noted, the main store automatically erases the original entry and starts afresh.

SIMPLEST APPLICATION

Dr. Booth states that French-English translation is perhaps the easiest application. Nevertheless, difficult constructions do occur, and a linguist's advice has to be sought.

The computer program is then modified to include new data.

Translation of German is now being studied, and has revealed greater difficulties.

Constructions that defeat even experienced linguists have already been encountered. In addition, the German vocabulary is far wider.

Despite Dr. Booth's work, translation by computer is unlikely to be considered a commercial proposition in the immediate future. The cost of translating 1,000 words on Mercury is £25, and the rate is 3,000 words an hour.

This relatively slow speed is due mainly to machine limitations. Locating and bringing a phrase from the main store takes, on average, one-fiftieth of a second.

What is needed is a computer with a 50,000-100,000 word random access store.

Claims have been made for very high translation speeds. "But these," says Dr. Booth, "are only vast electronic dictionaries. With complex languages, linguists are still needed to provide a fair translation from their results."

Russia, apparently, has 1,000 scientists studying machine translation.

Apart from translating material into Russian, it is interesting to note that they are concentrating on the translation of Russian into Chinese, Arabic and Indian tongues.

(From "Electronics Weekly")

UNIT PLAYMASTER

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The ideal combination. No. 2 Amplifier with Program Source and Dual 300S Player Unit. Available as a fully portable outfit as pictured above, or without boxes and carrying case for cabinet mounting. Note the attractive appearance of the Program Source when fitted in the unit amplifier box. Almost any combination of good quality speakers and player unit may be used with this remarkable amplifier, and we will gladly quote for combinations of your choice.

FULL PLAYMASTER RANGE

There's an Instrol Playmaster for every purpose. Designed by "R.TV & H." Playmaster brings you true fidelity for an extremely low figure. The range includes 17 Watt Stereo and Mono, 10 Watt Stereo and Mono, 5½ Watt Mono, 13 Watt Mono, plus a complete range of tuners embracing A.M., F.M. and Dual Wave. Also high quality kits to make your own speaker enclosures and equipment cabinets. The latest addition is a neat, compact enclosure kit for 8" speakers.

Specifications . . .

Performance figures and circuitry used as detailed in "R.T.V. & H." August, 1960. We supply best-quality components to "R.T.V. & H." specifications in all kits and completely built units.

POWER OUTPUT: A full seven watts per channel, rising to a maximum of eight watts per channel.

VALVES: Four — 6BM8 in twin U/L output, One — 12AU7 twin voltage amplifier.

RECTIFIERS: Two silicon diode 1N1763 rectifiers.

OUTPUT IMPEDANCE: 15 ohms. Others as required.

SWITCHING FACILITIES: (a) Stereo; (b) stereo (reverse); (c) mono; (d) radio tuner; (e) spare.

TONE-CONTROL RANGE: Treble cut and boost, 12 db; bass cut and boost, 12 db.

BALANCE-CONTROL RANGE: Equal both channels; to cut-off either channel.

INDICATOR BEZEL shows unit in operation.

FINISH: Modern metal case — Seamless welded, baked enamel, beige hammer-tone, self-contained. Attractive label — coffee brown, gold lettering. Beautiful imported knobs—Brown or Ivory, gold centres.

FITTING: Self-contained case (as above). Also available less case for panel mounting.

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23in., 21in. and 17in. MODELS

"R. TV & H." 110 degree DESIGN

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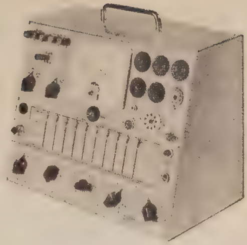

The very latest in tester designs. The "R. TV & H." valve and transistor tester originally described in the January, 1961, issue.

All the latest and most popular "R. TV & H." equipment designs in kit form. Low in price, easy to build, a fully illustrated instruction booklet accompanies each kit. Absolutely complete down to the last nut and bolt with all components to "R. TV & H." specifications. Designed by Australians for Australian conditions using readily available Ausralian components. Available through your local wholesaler, or direct from Broadway Electronics. We operate complete, fully insured, mail order facilities throughout the Commonwealth.

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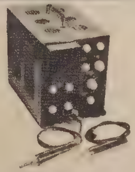
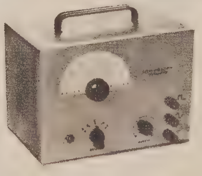


INSTROL-kit
3in OSCILLOSCOPE
R., TV & H., Aug.-Sept., 1960

Low in cost, yet extremely efficient in the servicing of TV sets. A most comprehensive instrument with which provision is made for the optional construction of probes. Vert. Amp. freq. response up to 3 mc/s.

INSTROL-kit
R. C. BRIDGE
R., TV & H., Sept., 1958.

Your resistance and capacitance measurements simple and accurate with this easy to build instrument. Will test condensers for leakage and power factor. Facilitates impedance checking.

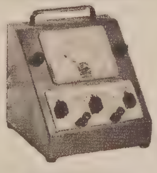


INSTROL-kit
Audio Oscillator
R., TV & H., April-May, 1960.

Highly suitable for audio testing on both square and sine wave. Freq. range 17 c.p.s. to 600 Kc. Constant O.P. voltage over full range.

INSTROL-kit
TRANSISTOR TESTER
R., TV & H., Aug., 1960.

Transistors are news — this efficient instrument, easy to build and simple to use, enables you to test all types of transistors and diodes. Uses 4in square "University" meter.



INSTROL-kit
Bench Type Vacuum Tube Voltmeter
R., TV & H. Jan., 1959.

For all TV and electronic work, this instrument is a must. "University" 4in square meter enables you to read 3 Volts to 1,000 Volts A.C. and D.C. Resistance measurements up to 1,000 megohms. Provision made for external R.F. probe.

INSTROL-kit
6-BAND SERVICE OSCILLATOR.
R., TV & H., Sept., 1960.

Ideal for radio alignment and may be used as a marker generator for TV. All INSTROL kits available with either black/silver panel or silver background with multi-colour figures.

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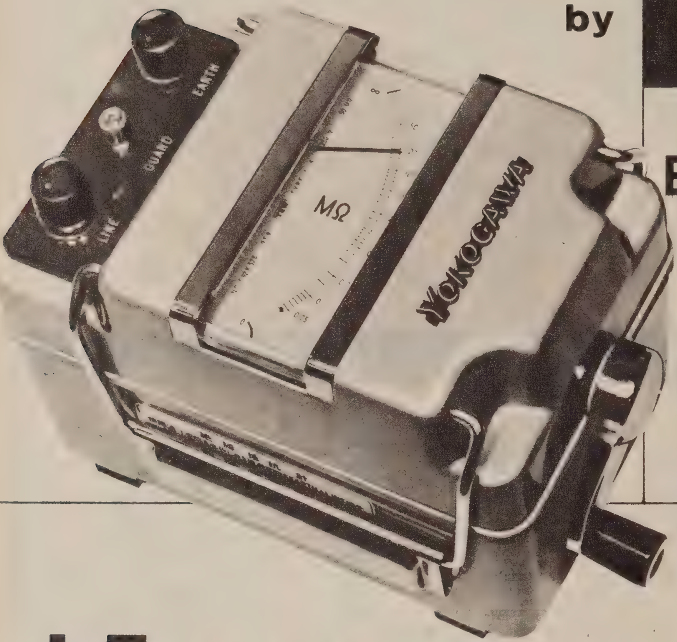

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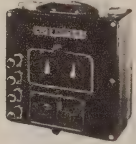

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QUEENSLAND: Mackay

OA-18

SCIENTIFIC & INDUSTRIAL NEWS

WATER DISTILLATION

A FLASH-TYPE water distillation system designed to operate unattended and continuously for long periods is shut down automatically in the event of failure.

Hot gases up to 1,000 degrees Fahrenheit and any heat source (conventional or nuclear) can be used. In all cases the heating medium is accepted directly into the plant without any intermediate boiler.

At present available are units designed to produce up to five million gallons of fresh water per day. In addition there are marine units with outputs from five tons to 40 tons and 10 to 150 tons per day respectively, the former using diesel waste heat.

A one million gallons-per-day plant, using specially produced steam, would yield fresh water at a cost of about 8/6 per 1,000 gallons, including labour, fuel, electrical costs and capital charges. If waste heat were employed and could be readily harnessed, production costs, it is estimated, would fall to about 1/6 per 1,000 gallons.

[Bennis Thermoflash, Little Hulton, Walkden, Manchester.]

SUN TURBINE

AN apparatus described as a sun turbine has been developed in Russia. It uses a special metal alloy which becomes non-magnetic when comparatively small increases in temperatures, such as those created by exposure to the rays of the sun, occur. It consists of a rotor designed as a system of rings mounted on a shaft. These rings are made of the special alloy. As the rings of the rotor rotate between the poles of the permanent magnet the path which is just between the poles is exposed to the sun's rays.

The cold portion of the rings is attracted by the magnet and this produces the force which causes the turbine to rotate.

The device, which is in a prototype stage, is now being developed for practical use.

[Further details from "Technical Digest," S.N.T.L., Spalena 51, Prague 1, Czechoslovakia.]

THINNER WIRES

COPPER and manganin wires one micron (one-thousandth of a millimetre) in diameter and suitable for use in the most sensitive of instrument coils can be produced at the rate of 600-800 feet a minute and in lengths of up to 6,000 feet using a new technique.

The wire rod is fed into a glass tube the lower end of which is surrounded by an induction heating coil. When the current is turned on, the glass softens, and the top of the rod becomes molten; the metal is then drawn out into a wire, solidified by a cooling device and continuously wound on to a reel. Strands of silver, gold and tin can also be produced under vacuum.

[Baykov Metallurgical Institute, Academy of Sciences, Moscow, Russia.]

HIGH RESOLUTION CAMERA

ONE of the problems which has hindered efforts to set up standard methods of determining resolving power for photographic materials has been that no camera having an adequate resolution for this purpose has existed up to now.

A new camera which seems likely to be suitable for such standards has now been developed. It is said to have achieved a resolution capability of 50,000 lines per inch. The system by which the camera operates is said to be unusually simple.

[National Bureau of Standards, U.S. Department of Commerce, Washington, 25, D.C., U.S.A.]

HEAT RESISTANT WIRE

HIGH-TEMPERATURE spring wire, usable up to 1,800 degrees Fahrenheit, is now available for special applications. The wire is a vacuum-melted nickel-base alloy with a tensile strength of the order of 250,000 pounds per square inch. It is available in diameters ranging from .2 to .004 inch.

[National-Standard Company, Niles, Michigan, U.S.A.]

EXPLOSIONS FOR SAFETY

DELIBERATELY set off explosions to counteract an explosion in an industrial plant are used in a new system of protection.

It is set into operation by a sensing device which detects an explosion within thousandths of a second. The device can work either from the flash or the increased pressure as the explosion begins.

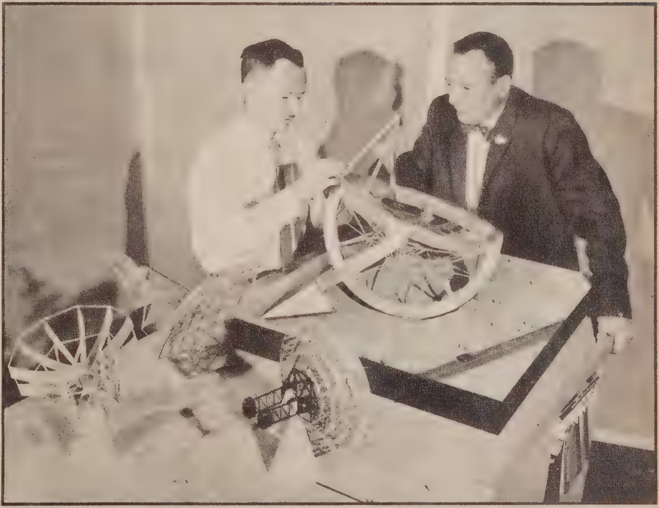
A series of counter-explosions can be arranged—some, for instance, to open vents in the plant to let the original explosion pressure pass to the outer air, and others to rupture thin-walled storage vessels and spray cooling compounds into the area of the major blast.

Charges can also be arranged to close off distant areas and throw switches which will shut down operations in the plant.

The basic idea is to achieve sufficient speed for proper measures to be taken before the accidental explosion builds up to a dangerous pressure.

[Fenwal Inc., 32 Pleasant Street, Ashland, Mass., U.S.A.]

AERIALS—ALL SHAPES & SIZES



To meet the evergrowing demands of communication, radar, space research, etc., a new aerial department has been organised by the Boeing Airplane Co. Taking advantage of the many years of experience gained in designing aircraft and missile aerials for its own projects, it now plans to make this experience available to anyone requiring specialised aerials. Shown in the photograph are some of the types designed by this organisation and indicative of the type of problem which interests them. The model being checked is that of a 200ft steerable aerial for radio astronomy. The two in the foreground are satellite tracking types, while between them is a section of a 50ft high radar surveillance aerial.

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"LASER" AID TO PHOTO-PHONE

The following item, taken from a recent edition of "Electronics World," should be read in coniunction with the article on page 9 of this issue concerning light beam communication systems. It would appear that the "laser" may be the technical break through required to make long distance light beam communication a practical reality.

AT a recent Press demonstration Hughes Research Laboratory scientists showed for inspection a new solid-state electronic device that can be used to amplify light. The device, smaller than a water tumbler and containing a rod of synthetic ruby, is an optical maser or "laser" (from Light Amplification by Stimulated Emission of Radiation).

Some possible future applications of the light amplifier include its use as a scientific tool for investigating properties of matter and for performing basic experiments of physics. The device will also permit focusing of light into high-intensity beams for space communications and industrial, chemical, and medical purposes. By communicating on the frequencies of visible light, there would be a large number of channels available that are not currently in use for communications.

Most of the applications of the laser stem from the fact that the device is able to generate "coherent" light. The smaller the portion of the electromagnetic spectrum over which any particular source generates energy, the more coherent is the source.

Previous sources of light energy, such as incandescent lamps, are "incoherent" sources since they simultaneously generate energy over a relatively large part of the spectrum. RF sources, on the other hand, are very coherent. The laser then is used to generate single-frequency light, much like an RF carrier, but in the visible-light portion of the spectrum.

In operation, a light source, in the form of a powerful flash-tube lamp, irradiates a synthetic ruby crystal which absorbs energy over a broad band of frequencies. This optical energy excites the atoms to a higher energy state from which the energy is re-radiated in a very narrow band of frequencies. The excited atoms are coupled to an optical resonator and stimulated to emit the radiation together, rather than individually and in random, as in ordinary light sources.

Small mirrored surfaces at both ends of the long, thin ruby crystal keep the light energy bouncing back and forth long enough for the proper interaction to occur. Small pinhole openings in the mirrored surfaces permit entry of the light that is to be amplified and emission of the amplified light at the other end.

Because of the coherence of the generated light, nearly parallel, needle-sharp beams could be generated less than one-hundredth of a degree wide. What is more, this beam would not spread or scatter as does ordinary light. As a result of such concentration, extreme brightness and intense local heat would be produced.

[Editorial Note: Since the above article appeared some of the "possible future applications" referred to have been demonstrated practically. In particular, experimental communication links have been successfully established over distances of 25 miles, with the light beam covering an area only a few hundred feet across at the receiving point.

Also envisaged is an earth-moon link providing all the communication requirements of a space expedition, and having a beam so narrow that it would illuminate an area only a few miles across at the end of its journey.

Even more recently, another technical breakthrough has been announced. While all experiments so far have exploited the particular characteristics of synthetic ruby crystals, scientists have been seeking a better material.

The main disadvantage of equipment to date has been the fact that it produced only flashes of light, not a continuous output. The latest laser uses a crystal of calcium fluoride in which one tenth of one per cent of the calcium atoms are replaced with uranium.

The light output from the new crystal is still in the infra-red region, but may be generated continuously, thus making it more suitable as a carrier for such complex signals as sound and vision.]

CONTROL OF PRESSURE LEVELS

ONE method of preventing pressures from building up to dangerously high levels in steam boilers and similar equipment is to incorporate a specially designed torsional bar which will shear at a predetermined critical pressure.

The difficulty of producing a steel having a chemical composition within such fine limits that it can be guaranteed to fail precisely at the right moment is claimed to have been overcome.

It is said that material having an analysis between only 0.1 and 0.2 per cent of carbon and of between 0.45 and 0.5 per cent of manganese, is now regularly being produced using conventional techniques.

[Richard W. Carr, Sheffield.]

GLASS-RESIN COATING

HIGH resistance to corrosion can be achieved by using a protective coating which includes a resin and hardener, glass fibre and, if required, a pigment. The material is applied by a special type of spray gun which mixes the ingredients and deposits the resulting product in a single application.

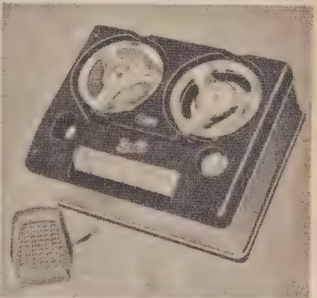
The glass fibre increases impact resistance and prevents shrinkage, while the intimate bond between the resin and fibre reduces the likelihood of "pin holes."

The makers say that one heavy coating will waterproof concrete and that steel coated with the material can be dented without flaking off the coating.

[Owens-Corning Fiberglas Corp., 717 Fifth Avenue, New York 22, N.Y., U.S.A.]

BEST TAPE RECORDER BUY SINCE 1900

At the Paris Exposition in 1900, Vladimir Poulsen exhibited the first type Tape Recorder. Since that date constant improvements in design and value have been made, till now, 60 years later, the famous Belle represents the greatest value ever in Tape Recorders. You will never see tape recorder value like this again.



49 gns.

The Belle features push-button operation, 1½ hours' playing time, twin track, 3-watt output.

Nowhere else in Australia will you get a more complete range of low-priced high-quality tape recorders.

TAPE RECORDERS

From £35 to £100

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SYDNEY TAPE RECORDERS

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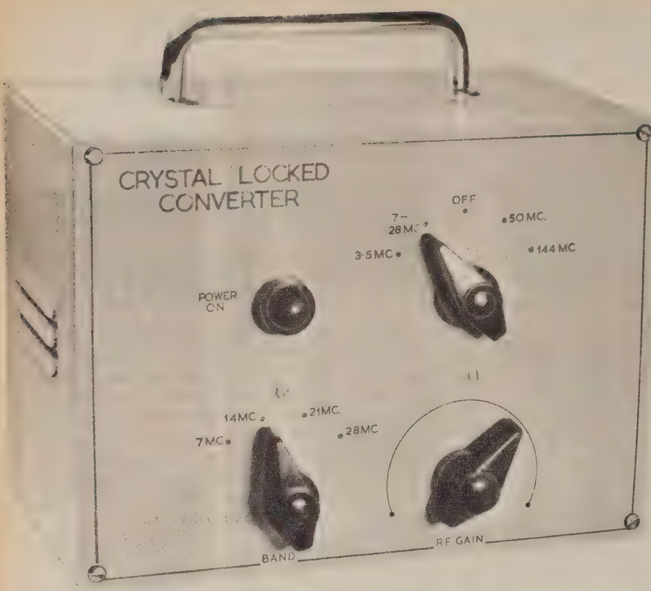


A front view of the crystal locked converter shows the placement of controls and the switch positions. The carrying handle fitted to the instrument case in which the unit is housed is optional.

Four Bands With A Single Crystal

Designed especially for use by Australian amateurs, this new crystal-locked converter provides for coverage of the bands 7 to 28 Mc, as well as straight-through operation on 3.5. Featuring bandswitching and a single crystal for frequency control, it offers an excellent combination of simplicity with high overall performance.

By Keith Jeffcoat

IN its present form, housed in a standard small instrument case, the converter is ready for immediate use with any communications type receiver covering 3.5 Mc. It can be used permanently in this fashion, but is so designed that it could become the "front end" of a completely new receiver featuring bandspread, double conversion and selectable sideband—in fact all the things that an amateur might want.

But let's commence the story at the beginning.

SSB PROBLEMS

The introduction of single sideband transmissions to the amateur bands has brought with it a number of problems, not the least being the high order of frequency stability required in a receiver to copy this mode of transmission.

One of the popular methods of solving the stability problem is to use some form of crystal-locked converter fed into a fairly low frequency receiver acting as a tunable IF system. In this arrangement the stability on all bands is virtually as good as that which can be obtained from the low frequency receiver alone.

The use of separate crystal-locked converters designed to feed into the BC-453 "Command" receiver, with its tuning range of 190-550 Kc, is a popular example of this general approach. While the arrangement does have good frequency stability, it also has certain disadvantages, the principal one being poor image frequency rejection.

A generally better plan is to use a fairly high first intermediate frequency and to double convert to a low frequency IF channel, in order to obtain the desired selectivity.

While this approach can yield the desired results, and is generally prefered on this account, it does call for some forward planning and for discretion in the choice of electrical specifications.

For example, a multiple conversion "receiver" can grow into something of a monster, if coverage is extended, converters added, facilities increased, along with power supplies, cables, switches, etc., each according to the whim of the moment.

Even if the owner is happy with the result, it is not likely to be something that others would want to copy.

PERFORMANCE STANDARDS

In the electrical sense, the general characteristics of selectivity, sensitivity, stability, noise, etc., all have to lie within acceptable limits, while, above all, the oscillator and intermediate frequencies have to be chosen to avoid having self-generated "carriers" and "birdies" within the desired tuning bands.

In this new converter, we have sought to meet and solve all these problems, and to present a simple, workmanlike design.

The converter is bandswitched to cover the 7, 14, 21, and 28 Mc bands and is designed to feed into a receiver having a tuning range of 3.5 to 4 Mc. The use of 3.5 Mc as a first IF gives good image rejection and means that the five HF amateur bands are covered with the one converter/receiver combination.

A single 3.5 Mc crystal serves all bands. The first half of a 12AT7 is used as a Pierce oscillator, with the output from its plate coupled through a 47 pF capacitor to the grid of the second section.

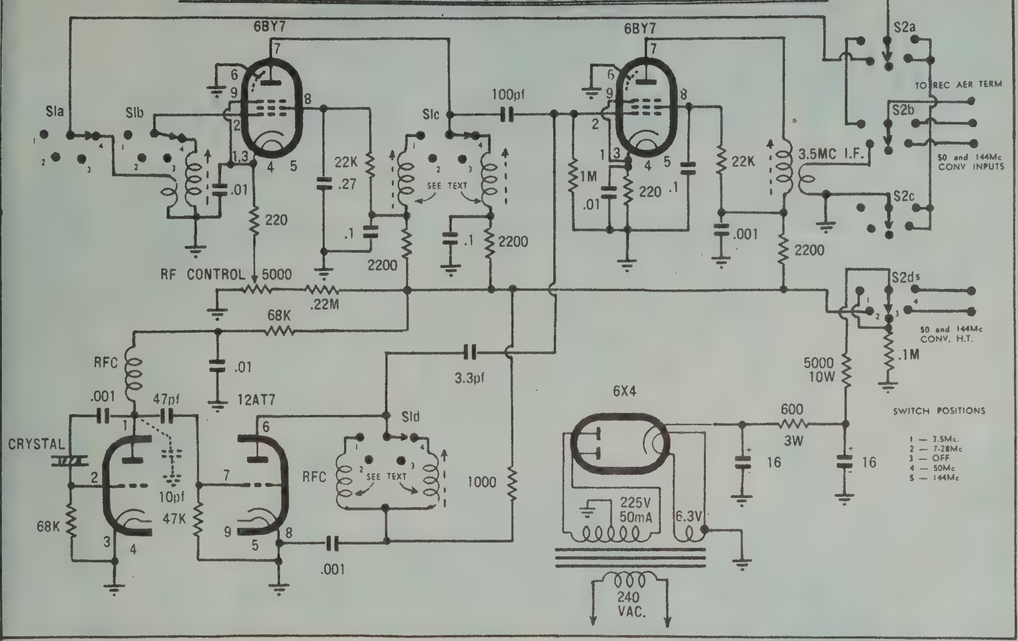
7 Mc OPERATION

When the converter is switched to 7 Mc this second section has an RF choke in its plate circuit, and acts merely as an aperiodic amplifier. Thus the output is on 3.5 Mc and this, mixed with the incoming 7 Mc signal, will provide a 3.5 Mc signal as a heterodyne resultant.

Switching the converter to 14 Mc puts a 10.5 Mc coil in the plate section and heterodynes the 14 Mc input down to the intermediate frequency of 3.5 Mc. The fifth (17.5 Mc) and seventh (24.5 Mc) harmonics are used to cover 21 and 28 Mc respectively.

(On 3.5 Mc the converter is not operative, the aerial being directed straight through to the basic receiver.)

FOUR BAND CRYSTAL LOCKED CONVERTER



The converter uses a single 3.5 Mc crystal to heterodyne the 7, 14, 21 and 28 Mc bands down to an intermediate frequency of 3.5 Mc. Switching is provided to accommodate existing 50 and 144 Mc converters and the unit has its own self-contained power supply.

Use of the 3.5 Mc crystal means that a handy band-edge marker is provided on all bands. A continuous carrier generated by this crystal will be present on the low end of all ham bands, and will prevent operation within about 3 Kc of this frequency. However, it is not good practice to operate right on the band edge, so the marker is more an advantage than otherwise.

Switching is provided to transfer the input lead of the main receiver from the outside aerial to the converter output or to the output from either of two VHF converters. This same switch grounds the main aerial when the VHF converters are in use to prevent "breakthrough," and has provision for switching the power supply into these converters if necessary.

An RF gain control consisting of a 5,000 ohm pot is included in the cathode circuit of the RF amplifier valve. This is needed to prevent overloading the front end, particularly by strong SSB signals.

AVC CIRCUITS

While no AVC line is shown connected to the unit, the use of variable-mu valves in the RF amplifier and mixer stages allows for this should it be desired. A 100 pF capacitor connected between the grid of the RF valve and the bandswitch, and a 1 meg. resistor from the grid to the main receiver AVC line, should take care of this problem.

Because the converter has no tuning controls in the normal sense, it is necessary for the tuned circuits to have a fairly broad response, at least over the range they are made to cover.

To this end, all coils in the unit are designed to resonate at the desired frequency with only their own and stray circuit capacitance. The only exception to this is the 7 Mc RF plate coil which was found to be too broad and needed the addition of a 10 pF ceramic capacitor connected across it to bring it into line with overall requirements.

The grid of the 6BY7 mixer valve shares a common tuned circuit in the plate of the RF valve to which it is coupled with a 100 pF capacitor, while a 3.3 pF capacitor coupled to the plate of the 12AT7 provides oscillator injection.

3.5 Mc TRANSFORMER

The 3.5 Mc IF transformer in the plate of the mixer was produced by modifying a standard Q-Plus AC-1 broadcast aerial coil as follows: Remove all of the secondary and replace with 14 turns of 32 B and S enamelled copper wire. This is to provide a low impedance match to the receiver input.

Resonance of the primary winding at 3.5 Mc is achieved by carefully removing 39 turns and resoldering the lead to the lug. Care should be taken to ensure that all the strands of the litz wire have been resoldered. Failure to do so will result in a severe loss of "Q" in this coil.

It is possible that commercial 3.5 Mc aerial, RF and oscillator coils may be available in the near future, in which case such modification would not be needed.

The power supply is simple and conventional, and, because it has to supply

1	**Power transformer 225V. per side 50 mA.**
1	**Rotary switch, 3-section, 2-pole, 4-position.**
1	**Broadcast Aer. coil (see text).**
1	**3.5 Mc crystal.**
2	**2.5 mH RF chokes.**
11	**7/16in by 1¾in fibre coil formers**

RESISTORS

1	**1meg ½ watt.**	**1**	**5K 10 watt.**
1	**220K ½ watt.**	**1**	**3.3K 1 watt.**
1	**100K 1 watt.**	**2**	**2.2K 1 watt.**
2	**68K ½ watt.**	**1**	**1K 1 watt.**
1	**47K ½ watt.**	**1**	**600 ohm 3W.**
2	**22K ½ watt.**	**2**	**200 ohm ½W.**

CAPACITORS

1	**16 mfd 600 volt surge electro.**
1	**16 mfd 300 volt working electro.**
1	**.27 mfd 200 volt paper or plastic.**
3	**.1 mfd 400 volt paper or plastic.**
3	**.01 mfd 200 volt paper or plastic.**
3	**.001 mfd 400 volt ceramic.**
1	**100 pF 200 volt ceramic.**
1	**47 pF 200 volt ceramic.**
1	**3.3 pF 200 volt ceramic.**
1	**10 pF 200 volt ceramic.**

VALVES

2 6BY7. 1 6X4. 1 12AT7.

MISCELLANEOUS

3	**Shielded min. 9-pin valve sockets.**
1	**7-pin valve socket.**
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1	**Crystal socket.**
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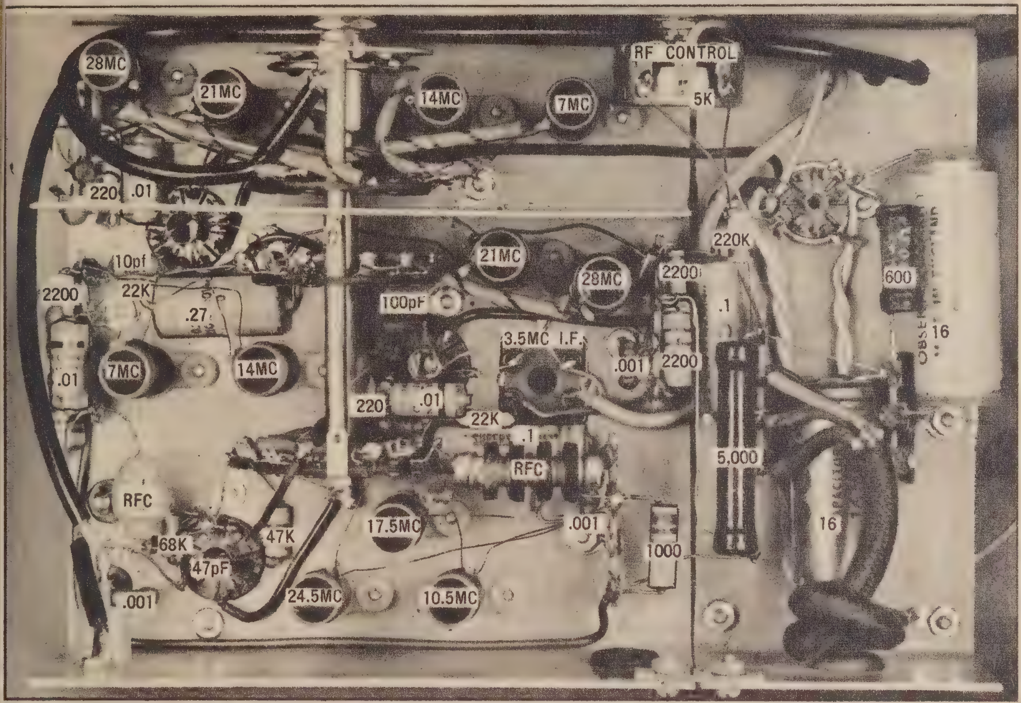

The RF amplifier valve is at the top left and has the shield plate running across the centre of its socket. The crystal oscillator is at the bottom left while the mixer valve and 3.5 Mc IF are in the approximate middle of the chassis

only the converter, a 600 ohm resistor is used instead of a choke in the filter network. Due to the low current drain of the unit, it was found necessary to insert a 5,000 ohm dropping resistor to bring the voltage down to 220 volts.

The converter is constructed on a 16-gauge aluminium chassis measuring 8in by 5½in by 2½in with a 9in by 6¾in front panel. A saw-cut can be seen separating the power supply end from the rest of the chassis. At some later date it may be desired to remove the converter from its case and install it in a complete receiver; hence the saw cut.

The coaxial socket mounted on the back of the chassis takes the converter output to the receiver aerial terminal and the additional hole fitted with a rubber grommet is provided for power supply leads to the VHF converters, if used.

LAYOUT

A glance at the photograph of the rear of the converter shows the layout adopted. The PF201 power transformer can be seen at the extreme left. The 6X4 rectifier valve behind it is obscured. To the right of these is the aerial switch, 3.5 Mc IF transformer and 6BY7 mixer valve. The 12AT7 oscillator valve and the 3.5 Mc crystal can be seen at the right, with the 6BY7 RF amplifier valve to their rear.

The underchassis view shows the main bandswitch at the left front and the RF gain control to its right. The shield plate can be seen passing through the bandswitch and across the centre of the RF amplifier valve socket, with the 220-ohm cathode resistor and its bypass capacitor to the left front of this socket.

COIL DATA

7 Mc Band

AER. Primary: 7 turns 32 B & S spaced 1/16in from end of secondary.
Secondary: 55 turns of 32 B & S.
RF. 65 turns 32 B & S with 10 pF capacitor connected in parallel.
OSC. No oscillator coil on this band, 2.5 mH choke used in plate of 12AT7.

14 Mc Band

AER. Primary: 4 turns 32 B & S spaced 1/16in from end of secondary.
Secondary: 24 turns 32 B & S.
RF. 24 turns 32 B & S.
OSC. 38 turns 32 B & S.

21 Mc Band

AER. Primary: 3 turns 32 B & S spaced 1/16in from end of secondary.
Secondary: 16 turns 22 B & S.
RF. 16 turns 22 B & S.
OSC. 18 turns 32 B & S.

28 Mc Band

AER. Primary: 3 turns 32 B & S spaced 1/16in from end of secondary.
Secondary: 10 turns 22 B & S.
RF. 10 turns 22 B & S.
OSC. 14 turns 32 B & S.

The aerial coils covering 7-28 Mc run from right to left between the shield and the front panel, while the RF coils covering 7-28 Mc run from left to right at the rear of the shield. This has been done to minimise coupling between the circuits.

SINGLE EARTH

All earth leads associated with the grid and cathode of the RF valve are returned to one common point on the front panel side of the shield plate, and the screen and plate feed bypass capacitors are returned to a common point on the other side.

This is necessary to minimise further coupling between the circuits and so prevent feedback occurring.

A 5-pin tagstrip near the 7 Mc RF coil is used to mount the 3.3K resistor and .1 mfd capacitor associated with the RF amplifier and the 68K resistor, and .01 capacitor supplying plate voltage to the crystal oscillator.

The three harmonic amplifier coils are mounted to the rear of the main bandswitch and a 5-pin tagstrip to their right mounts the 1K dropping resistor and .001 bypass capacitor and serves as a convenient tie point for the 2.5 mH RF choke used when the second half

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of the 12AT7 acts as an aperiodic amplifier on 7 Mc.

To the right and between the second and third wafers of the switch is the 6BY7 mixer valve socket and the 3.5 Mc IF transformer. The .01 cathode bypass is mounted directly above the socket and the 220K and .1 mfd screen dropping resistor and bypass capacitor can be seen to their lower right.

Just to the right of the IF transformer is a 5-pin tagstrip used to mount the 2.2K dropping resistor for the plate of the mixer and a 2.2K resistor which feeds the 21 and 28 Mc RF plate coils, the feed for the 7 and 14 Mc coils being taken from the 2.2K resistor on the opposite side of the chassis.

POWER SUPPLY

The layout of the power supply should be self-explanatory, with the first electrolytic and 600-ohm dropping resistor on the right, the second electrolytic in the centre and the 5,000-ohm resistor to the left.

The wattage value of these resistors has been chosen to accomodate the normal converter current drain of about 30 milliamps. Should it be necessary to draw more current than this from the power supply, the 5,000 ohm resistor should either be decreased in value or increased in wattage.

The line cord is secured by a knot inside the chassis and terminated on a 5-pin tagstrip.

Though the underchassis wiring may appear a little cramped from the photograph, no trouble should be experienced, as long as the basic wiring is completed before attempting to fit the wave-change switch and coils.

This switch is a 3-section, 2-pole, 4-position rotary switch, which was modified to suit the layout adopted. Each of the wafers has been reversed so that the pins now face the front of the switch and additional spacers are fitted between the wafers. The centre rotor shaft has been extended by cutting it off 3/8in from the clicker plate and fitting a new shaft coupled to the stub of the old one by a ½in brass connecting piece.

Spacing between the wafers of the modified switch is as follows: Between the clicker plate and first wafer 1in, first wafer and shield plate 3/16in, shield plate and second wafer ½in, second and third wafers 1½in.

The shield plate is constructed of 16-gauge aluminium sheet and measures 5½in by 3in. A ½in lip is turned down on one end of the 5½in length for securing the plate to the chassis and a piece cut from one end to clear the RF amplifier valve socket.

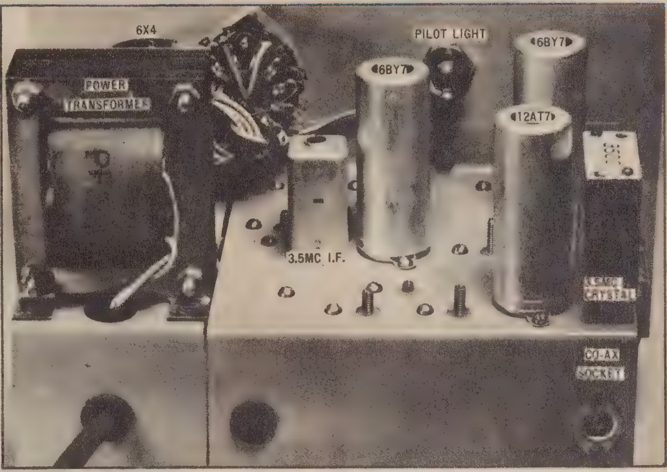
COIL DATA

All coils are close wound on 7/16in diameter by 1¾in long slug-tuned fibre formers. Because the slug is a neat fit it was not possible to secure the windings by passing the wires through the formers, so a method commonly used in commercial practice was adopted.

This consists of winding the wire twice around a piece of 2-mill. spaghetti, laying the spaghetti against the coil former, winding the coil over the top of it, and securing the end by once again winding it twice around the spaghetti.

After construction and initial voltage tests have been carried out, the converter will be ready for lining up. Providing the layout shown has been closely adhered to, and no great liberties taken with the coil data, little difficulty should be experienced.

REAR VIEW OF THE CONVERTER



Rear view of the converter shows the placement of all major parts. The crystal is a regrind mounted in a DC11 holder and the coax socket below it connects to the receiver aerial terminal.

While it is possible to align the converter on each band by ear, a far better job will be done if a signal generator is used in conjunction with an output meter.

The converter has an output impedance in the vicinity of 70 ohms and coaxial cable should be used to make the connection to the receiver aerial. The outer shield should be grounded at both ends or "breakthrough" will be encountered.

If the receiver has a preselector of the "R9er" type, this should be placed in front of the converter. DO NOT attempt to feed the converter through such a unit or severe oscillation, completely killing reception, will almost inevitably be the result.

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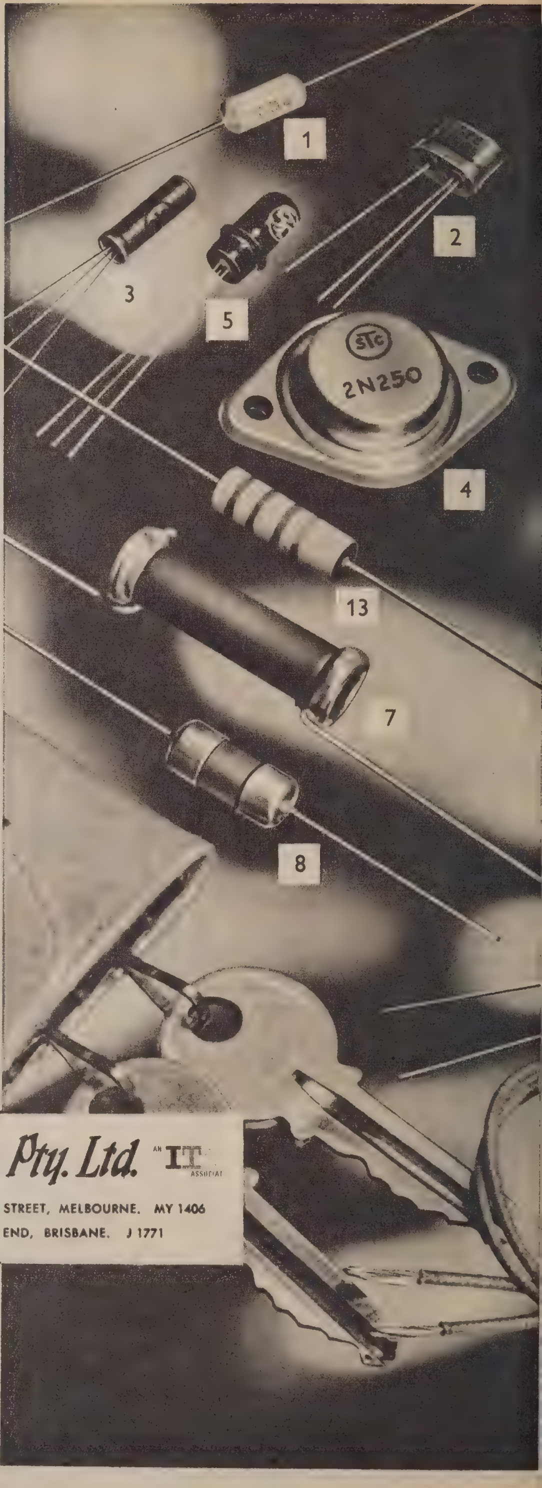

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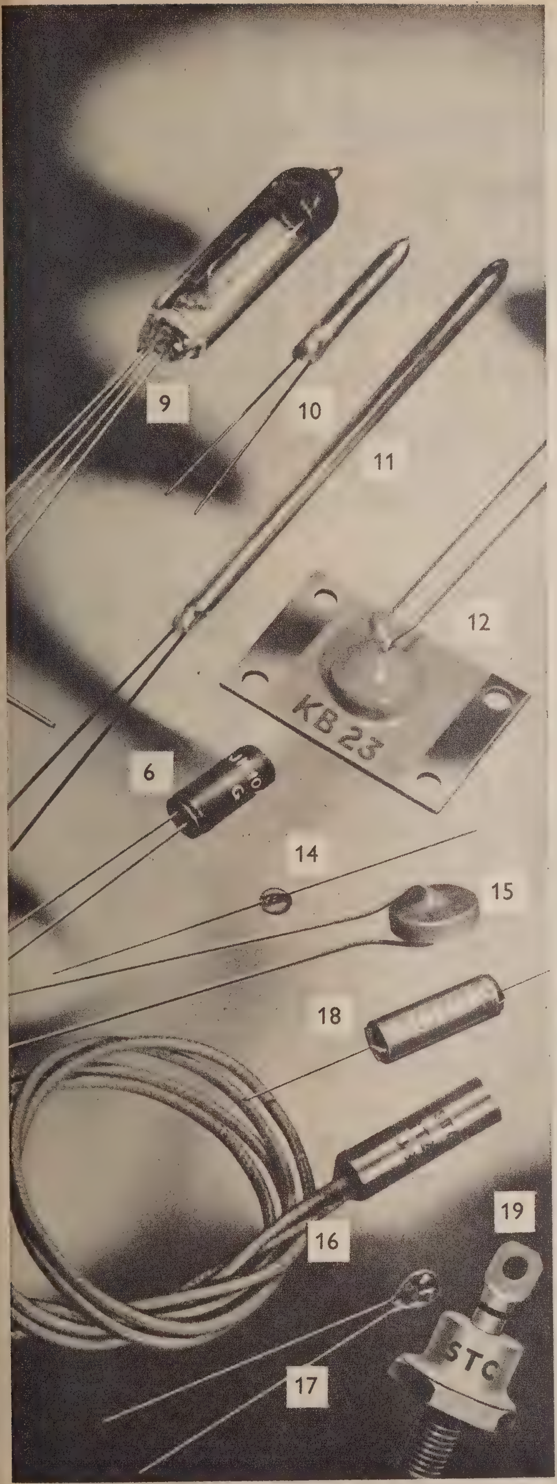

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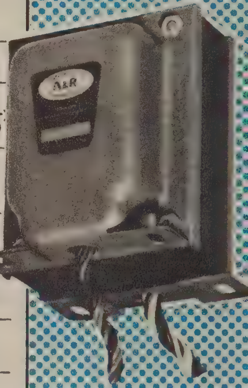

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Here's your answer, Tom!

As promised in the last issue, we are discussing this month the operation and use of the alternating current bridge circuit. The circuit used generally in electronics for the measurement of resistance and capacitance is used to explain its operation.

By Jamieson Rowe

SO far in this series, the only type of impedance with which we have dealt is resistance. When alternating currents are present, however, another type of impedance may become apparent. This is called **reactance,** and is associated with capacitive and inductive qualities of the circuit.

As previously explained, capacitance is the name given to the interaction effects between two insulated, adjacent conductors — when alteration of the electric charge on one conductor causes the charge on the other to alter. A physical "capacitor" is thus basically two conductors "side by side" but not in actual contact.

CHARGING CURRENT

If we apply a potential difference to such a capacitor, a charging current will flow. This current attains its highest value immediately after the potential is applied, diminishing thereafter towards zero as the charge voltage across the capacitor attains the value of the applied potential.

If we now reverse this applied potential, current will again flow — first to discharge the capacitor, and then to charge it in the new direction.

If an alternating potential is applied to the capacitor, this process will continue indefinitely. The faster the applied potential reverses, the larger the average current flow in each direction, because the current has less time to decrease before the potential has reversed.

We can thus say that a capacitor opposes alternating current flow to an extent depending on the frequency of the applied potential. We call the current resisting property CAPACITIVE REACTANCE, and say that it decreases with increasing frequency. This means that if we apply a potential of extremely high frequency to a capacitor, it passes a very high current and appears almost like a short circuit.

INDUCTANCE

Again, as we saw before, inductance is the name given to that quality of a circuit whereby the magnetic field produced by current in that circuit opposes any change in the said current. Coils, chokes and transformers are physically designed so that this effect is quite pronounced, and are accordingly called **inductors.**

Because they inherently oppose current change, inductors pass less current when higher frequencies are applied to them. This quality is called INDUCTIVE REACTANCE, which obviously increases with frequency.

We thus have two kinds of reactance, capacitive and inductive. The exact relationships of these quantities with frequency are given by:

CAPACITIVE REACTANCE

$$X_C = \frac{1}{2\pi f C}$$

INDUCTIVE REACTANCE

$$X_L = 2\pi f L$$

Because the current which flows in a capacitor is proportional to the rate of change of the applied voltage, while the voltage across an inductor is proportional to the rate of change of the current through it, it is apparent that there is a distinct difference between capacitive and inductive reactance.

In fact, if the same alternating potential is applied to a capacitor and an inductor, the currents which flow in each are in opposite directions. (We more commonly say "in opposite phase.") Because of this, the two types of reactance are found to be opposite in sign. Conventionally, we call capacitive reactance negative and inductive reactance positive.

Consider reactance of either type. At a specific frequency, it will have a magnitude proportional to the capacitance or inductance of the component concerned. In other words, we can find the value of a capacitor or inductor by noting its reactance at a known frequency.

This is where the bridge circuit can help us for, if we apply alternating voltage to a bridge, we can use it to find almost any unknown impedance, whether it be resistive or reactive. Figure 1 shows the basic AC bridge circuit.

On the left we can see the familiar bridge circuit, but with a few differences. Instead of the battery to supply a potential, we now have a source of alternat-

☆

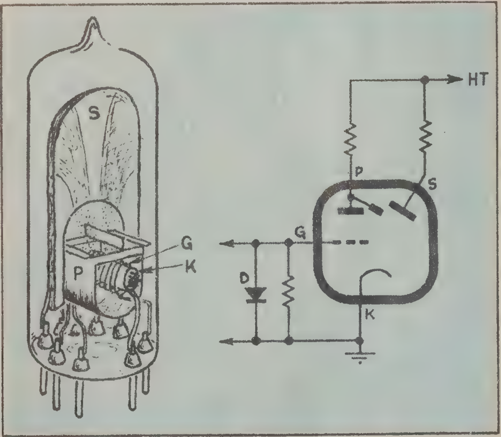

Figure 2, on the right, illustrates the operation of "magic eye" type of indicator, frequently used in bridges to indicate the balance condition.

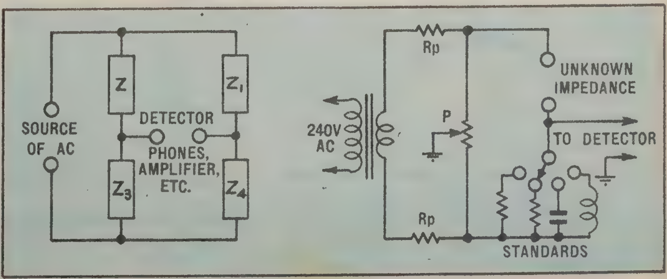

Figure 1, below, shows the basic configuration of an impedance bridge and a more practical circuit arrangement involving resistance, capacitance and inductance standards.

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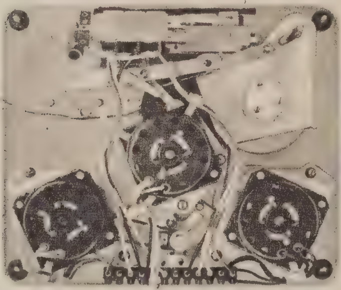

SPECIFICATIONS

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Track Width	.087″ - .091″.
Number of Tracks	Two.
Record/Playback Sense	Left to Right only.
Number of Motors and Type	Three. Four pole, Induction, dual voltage.
Voltage	200-250V. 50 cycle & 110/50 cycles by change of connections; 110V. 60 cycles by change of motors.
Operating Consumption	Max. 24 watts at 230 volts.
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Number of Heads	Two.
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ing potential. This may be a transformer supplying 50 cycles from the power mains, an oscillator circuit using a valve, or simply a buzzer to interrupt the DC from a battery.

The alternating potential from the source is applied between top and bottom of the bridge circuit proper. As before, the bridge is obviously made up of two potential dividers. However, whereas all the elements were formerly resistive, they are now under the general category of impedances—resistance, reactance, or both in combination.

The same rule still holds, however, namely that the bridge will be balanced when the ratio of impedance Z to impedance Z3 equals the ratio of impedance Z1 to impedance Z4. The detector in this case is one sensitive to AC and may be a pair of earphones, an amplifier feeding a meter or speaker, or a "magic eye" cathode ray indicator. Null or balance is still indicated by a "dip" or drop in the detected signal.

PRACTICAL CIRCUIT

On the right of Figure 1 is shown a simple practical version of this circuit. For an AC source, the circuit uses a step-down transformer from the power mains. This supplies 6.3 volts 50 cycles to the bridge. Placed in series with the source are two protective resistors Rp in case the bridge become accidentally shorted. The resistors prevent excessive current flowing in such an event.

Instead of the two separate arms of the bridge Z1 and Z4, we have the potentiometer P. The moving arm of this pot. is earthed, making the upper section of the pot. correspond to Z1 and the lower section to Z4. The ratio between Z1 and Z4 can be varied by simply turning the pot. In practice the pot. shaft is fitted with a large indicator dial on the panel of the instrument, and is calibrated for the Z1/Z4 ratio in each position.

The other part of the bridge is made up of the unknown impedance Z connected between the terminals, and a standard impedance selected by the switch. In the circuit shown, an unknown resistor is compared with a standard resistor, an unknown capacitor is compared with a standard capacitor, and an unknown inductor with a standard inductor.

OTHER TYPES

Other types of AC bridges, such as the Hay and Maxwell types, compare capacitors with inductors and vice-versa, but use different bridge arrangements.

The detector for a bridge of this type is usually a "magic eye" cathode ray indicator tube. The signal from the bridge circuit is first amplified and rectified into a DC signal and then applied to a metal plate or plates which are near a stream of electrons issuing from a hot cathode.

As the voltage on the plate or plates varies, the attraction between it and the electron stream changes, and the stream narrows or widens. The stream is allowed to impinge upon a metallic oxide surface, which glows when bombarded with electrons. Thus the glow visible on the screen varies in size with the input voltage applied to the plates, allowing visible monitoring of the voltage. The tube thus forms a convenient detector for the bridge.

A clearer idea of the operation of the magic eye tube may be obtained from Figure 2, where a sketch of the tube is shown.

The AC bridge circuit which we have been discussing is not normally used for inductance measurement, incidentally, being known usually as an "R-C Bridge." This is because the measurement of inductance, particularly when iron-cored inductors are concerned, has to be carried out under specific conditions. Other bridge circuits allow the inductance to be measured with known currents flowing through the inductor and at specific frequencies. They also allow measurement of the DC resistance of the inductor at the same time.

POWER FACTOR

Sometimes a bridge of the type shown in Figure 1 has a control marked "Power Factor" on the front panel. This is provided because some types of capacitor (such as electrolytic types) inherently possess an internal resistance, which is effectively in series with the capacitance element.

The power factor control is a variable resistance placed in series with the capacitor standard, and used to balance the resistive component of the capacitor under test. The control is calibrated in power factor, which is the ratio of the resistance of the unknown capacitor to its total impedance (equal to the square root of [R squared plus Xc squared].)

Well, Tom, that brings us to the end of our discussion of the AC bridge. Next month we will commence the discussion of another important measuring instrument, the cathode ray oscilloscope.

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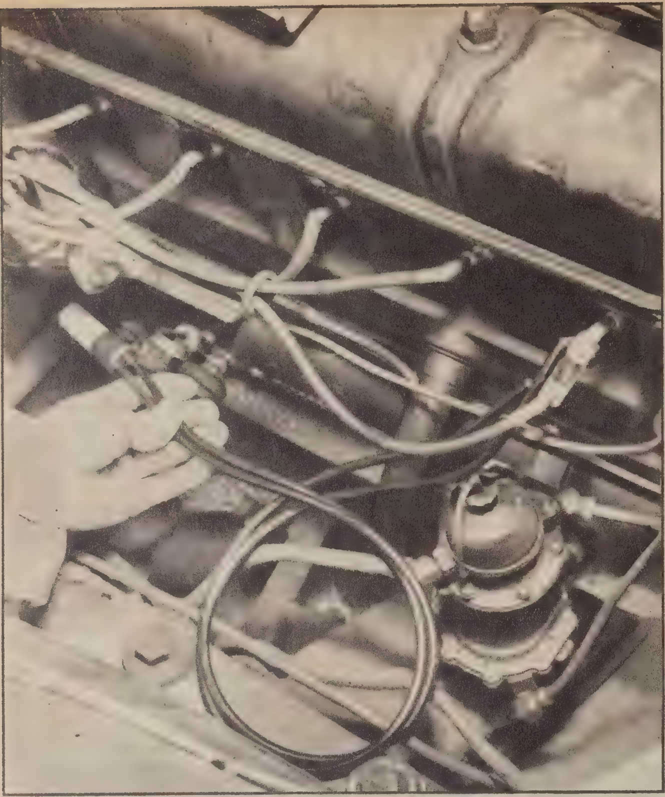


Some, at least, will recognise this as portion of a Holden engine. Note how the timer connects in series with the normal lead to the number 1 spark plug.

An Ignition Timing Light For Your Car

This very simple neon timing light can be put together for a few shillings but it will take the guesswork out of ignition timing. Full constructional details of the timer are given, together with a few hints on its practical use.

A MOTOR vehicle is not unlike a radio set in that certain sections require a periodic "tune up," to ensure that maximum performance is maintained.

The timing light which we describe this month is designed to assist in such a tune-up, as it will indicate accuracy of the ignition timing with the engine running.

Most modern cars have a timing mark on either the flywheel or crankshaft pulley. In a correctly adjusted motor this will be opposite its corresponding index mark, usually when the piston of the number one cylinder is at top dead centre.

To carry out a dynamic test, which will indicate the condition of the ignition timing, it is only necessary to connect a suitable timing light in series with the number one cylinder's plug lead and direct the light on to the timing marks.

With the motor idling at about 400 r.p.m. the moving mark should appear to be stationary and exactly opposite the fixed index mark. Deviation from this position will indicate whether the motor is advanced or retarded in its timing.

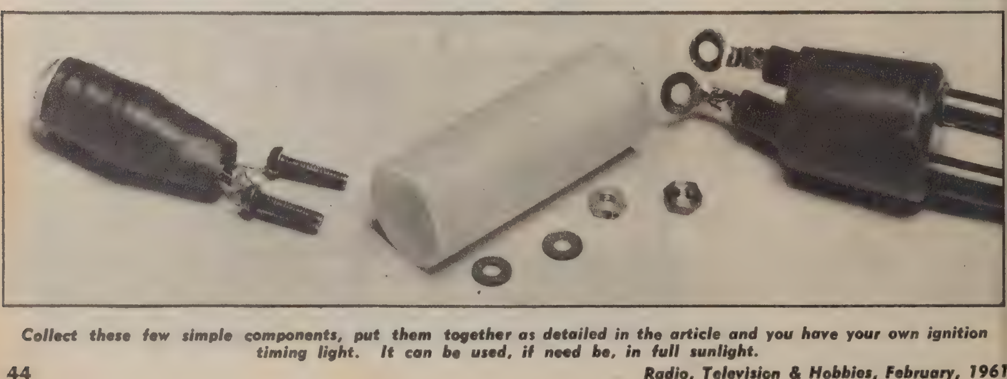
There are many types of timing lights on the market today, from the simple neon, with its fairly low light output, to the more complicated electronic flash tube type which has a very high light output.

MATTER OF COST

While the electronic flash type has a distinct advantage, by reason of its high light output, it is a fairly costly device to build. This is an important consideration, especially if only used once or twice a year, as would be the case with the home mechanic, to whom this article is directed.

For such use, a neon tube timer would appear to be the obvious choice. While its light output may not be very high, it is sufficient to perform the job required of it, even under bright daylight conditions. It is both cheap and easy to construct and is very robust; the tube has an almost unlimited life, it is not possible to damage the tube by wrongly connecting it and the final unit can be made compact and easily portable.

Our timing light is constructed around a type PL neon tube, distributed in Australia by W. J. McLellan and Co. Pty. Ltd. Originally designed for use as a panel indicator, this lamp has a built-in



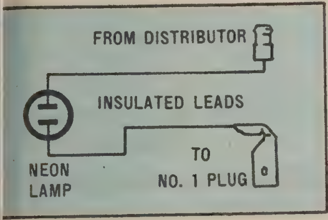
Collect these few simple components, put them together as detailed in the article and you have your own ignition timing light. It can be used, if need be, in full sunlight.

lens, which tends to concentrate its available light output into a single spot.

In the unit described, a slight increase in light output is achieved by wrapping a 1-inch wide piece of aluminium foil around the tube, and securing it by several layers of plastic insulation tape.

To prevent accidental damage by rough handling, the tube is housed in a three-quarter-inch by two-inch plastic radio type coil former. Fitting of the tube into the former is accomplished by soldering a 1/8-inch by ¼-inch Whitworth bolt to each of the leads protruding from the base and passing these bolts through two 1/8-inch holes drilled in the base of the coil former.

A 36-inch length of high tension cable is attached to each of these bolts by means of a solder lug held in place with a 1/8-inch nut.



Perhaps it is unnecessary but, somehow, no project in "Radio, Television and Hobbies" seems complete without a schematic circuit.

In order to prevent the user from coming into painful contact with the high voltage present at these terminals, a ¾-inch inside diameter plastic crutch tip, with two ¼-inch holes drilled in the base, is used as a cover.

Connection of the timer in series with the number one plug lead is accomplished by means of a simple adapter. This is constructed from a length of ½in diameter by 1½in long Perspex rod with a 3-16in hole drilled through the rod ¼in in from each end.

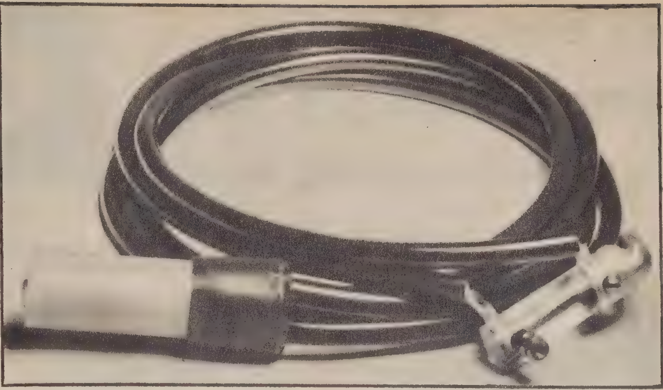
One end of this rod has a Utilux H-121 spark plug cap and a solder lug attached to it by means of a 1-8in by ¾in nut and bolt. The other end is fitted with a spark plug terminal and solder lug held in place by a 3-16in by ¾in bolt.

Soldering of the two wires from the neon tube to the solder lugs at each end of the adapter completes the unit, which is now ready for use.

Before placing the timer into service it is essential to check and adjust, if necessary, the distributor contact points and spark plug gaps. Failure to do the former, at least, may result in incorrect setting of the timing.

CHECK POINTS

If the distributor points are badly pitted or worn it would be advisable to replace them. The opening of used or worn contact points cannot be measured accurately with a feeler gauge because of the irregular shape of the contact surfaces. The gauge measures between the high spots on the points instead of measuring the true point opening.



The completed timing light. Additional information on timing procedure will be found in many workshop manuals covering individual makes and models. Where timing marks are not already provided, they can often be added.

Since this point opening decreases as wear takes place on the rubbing block it is advisable to always set the points as close to the high limit as possible.

Before replacement of the distributor cap, wipe it out with a clean cloth and inspect for chips, cracks and carbonised paths which would allow high tension leakage to ground.

Next in line are the spark plugs, which should be removed for cleaning and gap setting.

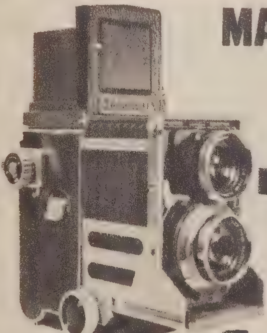
Before replacing the plugs, turn the motor by hand until the timing marks mentioned previously are visible. Clean their surface and place a chalk mark on each. This will assist by making the marks clearly visible during timing.

The timing light should now be connected, by means of its adapter, in series with the number one plug lead.

With the motor running, direct the light on to the timing marks and observe their position. If they do not coincide, the distributor adjusting arm or body should be moved until they correspond and the distributor locked in this position.

Using the timing light it is also possible to tell whether the automatic ignition advance is functioning correctly. When the engine speed is increased to a fast idle (around 800 r.p.m.) the timing mark should appear to move in the direction in which the motor is rotating.

This movement should be approximately 6 degrees at 800 r.p.m. and around 30 degrees at 3,500 r.p.m.



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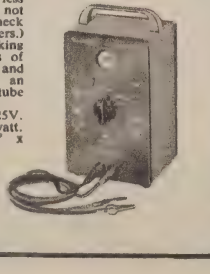

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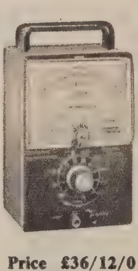

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FROM THE SERVICEMAN WHO TELLS

Several readers have offered helpful comments on the destructive charges used in wartime equipment, and the risk of these falling into the hands of enthusiasts via ex-disposals sources. Considering what may be involved, I feel bound to pass these on for the benefit of readers. From the service bench I have a couple of interesting TV faults.

FIRST, the "explosive" comments.

In the issue of October last I reprinted a letter from a reader who had had the misfortune to mistake a detonator (ex-disposals equipment) for an electrolytic capacitor—with rather painful results.

In fact, of course, he was fortunate. Painful although the experience may have been, at least no permanent damage resulted. Unfortunately, many detonator accidents have more serious consequences, since these harmless-looking gadgets can shatter a hand, or blind an eye with the greatest of ease.

GRIM PLAYTHING

(A recent newspaper report told of a four-year-old boy nonchalantly chewing on one of these while accompanying his mother on a shopping expedition. Apparently she was as ignorant of the true nature of his plaything as he was, and only the quick thinking of an observant bystander prevented a tragedy.)

Since the article in the October issue I have received additional information concerning detonators in general and their use in disposals equipment in particular. In view of the dangerous nature of these devices I feel I should pass this on for the benefit of all concerned.

First comment came from a senior member of the R.A.A.F.—also an active ham—who rang the technical editor to draw attention to a valuable reference on this subject. In the American amateur journal "QST" for May, 1949 (page 31) appeared a list of service equipment known to contain destructive charges. They are as follows:—

SCR695, SCR595, SCR535, ABE, ABD, ABK-1, AN-APX1, or 2, 3, 8, 13.

ALL AVAILABLE

All these have been available on the Australian disposals market at some time, while there may be others which did not find their way on to the U.S. market. And, in spite of the time which has elapsed since the war—or perhaps because of it—there is still a chance that amateurs and others may encounter these devices without being aware of their true nature.

And just what form did these destructive charges take?

As far as I can make out, the units listed above carried one of two types. One was housed in a cardboard tube, about four inches long and an inch in diameter. The tube itself may still be found on many units, although the charge will have been removed.

The other was a rectangular container of heavy cardboard, about 4in x 2in x 1in. This, apparently, is completely removed during the "de-lousing" procedure.

It should, perhaps, be emphasised that these charges were not simply detonators, but apparently contained a fair quantity of gelignite or similar explosive. The detonator was required simply to fire the charge. Thus they are extremely dangerous and capable of inflicting serious or even fatal injuries.

The other comment came from a reader whose work apparently involves a knowledge of explosives. He forwarded a pamphlet containing details of explosives and detonators, and suggested that the detonator pictured in the October issue was a standard 3-second delay electric blasting detonator, as illustrated in the pamphlet.

To enable readers to familiarise themselves with this device I am reproducing the diagram, together with the original detonator reconstructed as much as possible.

DETONATORS ONLY?

Which raises the question as to whether some of the destructive charges in disposals equipment may have been detonators only, assuming that a large destructive force was not required. Alternatively, some enthusiast may have salvaged the detonator only, believing it to be a standard radio component and unaware of the true nature of the explosive material accompanying it.

In any case, anyone handling ex-disposals equipment should be constantly on the look-out for anything which could be an explosive, particularly if it does not appear to form a logical part of the main circuit. If in doubt, it would be better not to use a component which cannot be positively identified.

Even more important is the need to do the right thing when such a device is encountered. Don't discard it indiscriminately, or toss it in the junk box with the mental reservation that it might be dangerous. That is one sure way for these things to find their way into the hands of children or other people who may not recognise them.

To prevent any risk of a serious tragedy they should be handed over to the police or army authorities for proper destruction.

BACK TO THE BENCH

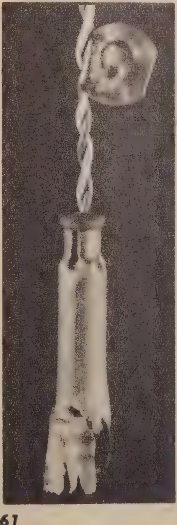
Turning to more everyday matters, I recently encountered two intriguing TV faults—very similar in many respects—and which were rather unique in themselves.

One of the trickiest problems a TV serviceman encounters is that of interference patterns superimposed on the picture. One snag is that the condition is not necessarily constant; it may vary according to the time of day, the channel, the locality, etc., making it a difficult job even to get to grips with it.

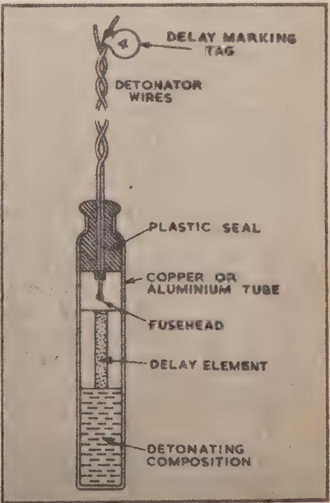
And when he does, he has to decide, first of all, whether it really is a fault in the set or whether it is due to some form of outside interference. Then, if it is in the set, it is a fundamental design fault or has something suddenly slipped? Or, if it is outside interference, is there anything that can be done about it, either technically or legally?

All of which adds up to a fairly formidable array of "ifs." Fortunately, there are ways of eliminating at least some of these, and thus narrowing the field. The two cases I encountered recently were excellent examples of this type of problem.

In both cases the complaint was simi-



Reproduced at the right is a diagram, submitted by a reader, of a delay type detonator as commonly used in blasting operations. The figure "4" on the delay tag indicates a 4 second delay. At left is the detonator originally submitted by A. C. W. H, and which appears to be of the same type.



Ortofon PICKUP ARMS AND HEADS

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Australian National Distributors: **Simon Gray Pty. Ltd.** 28 Elizabeth Street, Melb. Phones: MF 8211, 8166 r; "stripes" or "lines" on channel 7. The customers' expressions—not mine.) little discreet questioning is always elpful in such cases and when the first wner had described the effect as best e could, I made a preliminary attempt eliminate some of the least likely auses.

First, was the effect present at all imes?

He wasn't too sure about this, but aid he thought it came and went fairly uickly.

Was the pattern stationary, or did it ilt from left to right?

He didn't hesitate this time, yes, it lefinitely tilted, and when it tilted far nough it disappeared for a few seconds, hen reappeared. Then he volunteered he suggestion that this total effect was resent all the time.

From this it appeared that the trouble vas a conventional interference pattern, lrifting at random, but present at all imes when the set was tuned to chan- el 7. While not conclusive by any neans, it is a fair assumption that a attern which is present at all times is nore likely to be due to the receiver han an outside source. After all, most utside interference will have periods of nactivity, whether it is due to a faulty mateur rig, diathermy unit, or even an- ther TV set with serious radiation.

OTHER SETS TOO?

It is also handy to know whether other sets in the vicinity are experiencing the same trouble. If they are, then some local source of radiation is probably to blame; if not, it is most likely in the set. In this case the customer said he had not heard any complaints from his neighbours of similar trouble.

Since he had also implied that the trouble was of recent origin it seemed fair to assume that (1) the trouble was due to a fault in the set rather than outside interference, and (2) it was a recently developed defect rather than a design weakness.

Well at least that was something.

I made a quick check of the set's performance in the owner's home, confirmed his description of the effect, then loaded the chassis into the truck and took it back to the shop. Assuming that the problem was not one of environment, it was far more logical to tackle it in the comparative comfort of my own workshop.

Any lingering doubts I may have had on this score were dispelled when I tested the set again and found that it behaved exactly as it had in the owner's lounge-room. The interference produced a plain bar pattern of roughly the same spacing as occurs on channel 2 in the case of the classic "herringbone" interference. (Serviceman, May, 1959.) However, there was no herringbone pattern in this case, just plain bars, suggesting that the sound carrier was not involved.

As I mentioned in the May, 1959, issue, it is possible, at least in theory, to count the number of bars and calculate the video frequency of an interfering pattern. Where this can be done it may provide a useful clue as to its origin, but, in practice, the pattern is seldom stationary long enough to permit more than a rough estimate.

One idea is to hold a rule up against the screen, wait until the pattern drifts into a vertical position, then note how many bars occupy a small length of the rule, say one-quarter or one half-inch. If one has taken the precaution to reduce the picture width so that there is no horizontal over-scan it should be possible to make a reasonable estimate of the number of lines in the whole scan.

IMPRESSION CORRECT

In this case my estimate worked out at approximately 130 lines, which checked up with the original impression that it was similar to the 2.25 Mc pattern encountered on channel 2. So, give or take a quarter of a megacycle, I settled for 2.25 Mc beat. And, whatever the cause, it apparently did not involve the FM sound carrier.

But where did I go from here? While observation and simple arithmetic had eliminated several possibilities, I still did not have any very clear idea of what the trouble was.

Without knowing exactly what I expected to find I decided to check the alignment anyway, in the hope that it might reveal a clue. And, as they say in the who-done-its, this gave me my first real break.

At first glance the response curve looked reasonable enough; not perfect, but having the correct general shape. The main faults appeared to be an excessive dip in the centre, and an incorrect "slope" around the 36 Mc region. But, while undesirable, I couldn't quite see how this might be related to the present trouble.

Running over the response with the marker generator gave a clearer picture of what had happened. Apparently the circuit or circuits associated with the 36 Mc end of the response had drifted high, leaving the gap in the centre and lifting the response at 36 Mc until it was nearly up to reference. After that the response dropped rapidly due to a 37.5 Mc adjacent channel trap, then rose again to give a substantial hump around 38 Mc.

Having carefully noted all this, in case it should be significant, I proceeded to correct the condition. There was only one major adjustment necessary, which shifted the hump bodily toward the low frequency end, filled in the dip, straightened the slope, and dropped the 38 Mc hump.

And, believe it or not, that was all that was needed to completely cure the trouble!

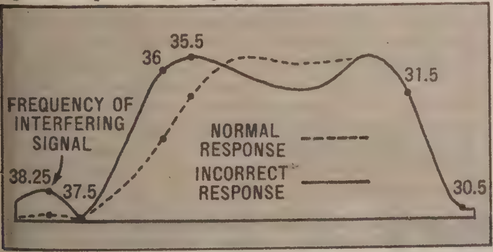
PROBLEM

Why? I'm afraid I couldn't answer that one right off, but I was determined to find an answer if I could, if only for my own peace of mind.

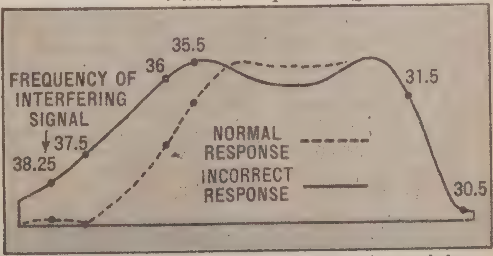
The most important clue seemed to be the spurious IF response around 38 Mc. Since this constituted the major deviation from a normal response it seemed reasonable to assume that, whatever the origin of the interfering signal, it was finding its way into the system by this means.

Probably the most frequent cause of interference patterns (generated within

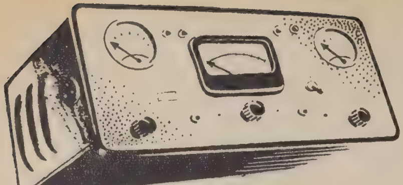
Watch out for this! It is the cardboard tube used to house an explosive charge in many items of disposals gear. Unless it is completely empty treat with extreme caution. The panel fitting on the left is the opening through which the charge was fitted.



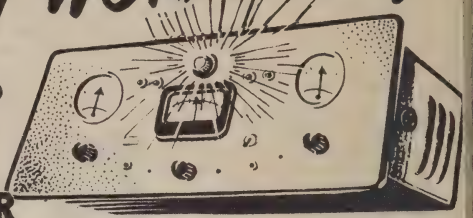
Case No. 1. A maladjusted response curve, with the high frequency hump higher than it should be, caused excessive response beyond the 37.5 Mc trap point. An interfering signal at 38.25 Mc was thus able to reach the video detector.



Case No. 2. The same interfering signal was being admitted, partly due to a similar maladjustment, but mainly because the 37.5 Mc trap also had drifted high. Any appreciable response beyond this trap point should be treated with suspicion.



IS IT WORKING?



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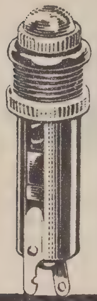

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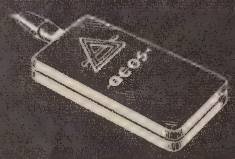

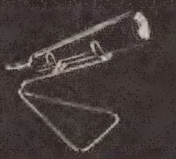

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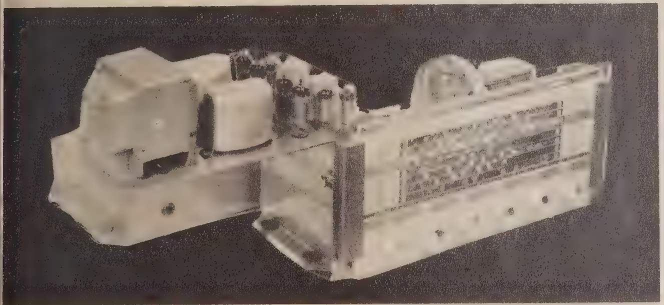

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Serviceman Who Tells

(Continued from Page 51)

Once we assume that this response is vider than it should be, a whole new ange of possibilities present themselves, lepending on the exact frequency range overed by the spurious response.

If you're very clever you may be able o nominate the trouble by mathematical alculation. Otherwise you'll do what I lid: cure the trouble on a trial and rror basis, then work backwards to stablish the cause!

But the moral is fairly obvious: whenever such troubles are experienced one hould be prepared to check and, if lecessary, adjust the response curve to nake certain that it is responding only o those frequencies which it is designed o receive.

GOOD ADVICE

And it was only a couple of weeks ater that I had occasion to act on my own advice. A second case of virtually dentical symptoms was encountered, the only variation being that the pattern was a little less obvious. Nevertheless, it was bad enough to annoy the owner and prompt him to seek my advice.

Because it followed so closely on the first case, I was naturally conscious of this particular fault immediately the symptoms were described. On the other hand, I felt it would be something of a coincidence if two rather rare faults should land in my workshop within such a short time.

Nevertheless, my first job, after confirming the symptoms, was to check the response curve. I was somewhat pleasantly surprised to find that, in general terms, the trouble was the same as before, i.e., excessive response around the 38 Mc region. However, in detail, the cause was somewhat different.

Whereas some of the trouble was due to one of the humps having drifted towards the high frequency end, as in the previous case, the main trouble appeared to be due to a faulty trap circuit.

Most IF strips employ an "adjacent channel trap" tuned to 37.5 Mc, the sound IF of the adjacent channel if it should be occupied. In addition to rejecting this specific frequency, it helps to shape the curve around the 36 Mc region, as well as minimise response above the 37.5 point.

TRAP TROUBLES

But not in this case. The trap had obviously "walked" and was somewhere up towards the 40 Mc region, as nearly as I could judge. As a result the slope above the 35.5 Mc point did not drop at the normal angle, but trailed off gently to a point well beyond the 38 Mc region. Thus the response was up slightly at 36 Mc—which was wrong anyhow—and still quite appreciable at the critical 38.25 Mc point.

Correction was similar to the first case, except that I also had to locate the 37.5 Mc trap and set it back on frequency. And I was very gratified when a check showed that the trouble had been cured just as effectively in this case as in the first one. If any confirmation was needed that my theory was correct, this seemed to be it.

Summing up, we may emphasise the following points:

Whether interference patterns are due to an outside source or are within the set may be judged on (1) whether the effect is continuous or intermittent, (2) whether it is observable in neighbouring receivers, and (3) whether it remains evident when the set is moved to the workshop.

Observation of the pattern to determine whether it contains a herringbone effect will establish whether or not it is related to the sound IF rather than the video IF, and this may assist in working out a possible cause.

Finally, treat any over-broad response curve as highly suspect and correct the condition as a matter of course.

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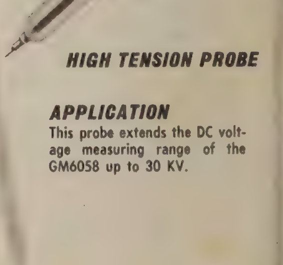

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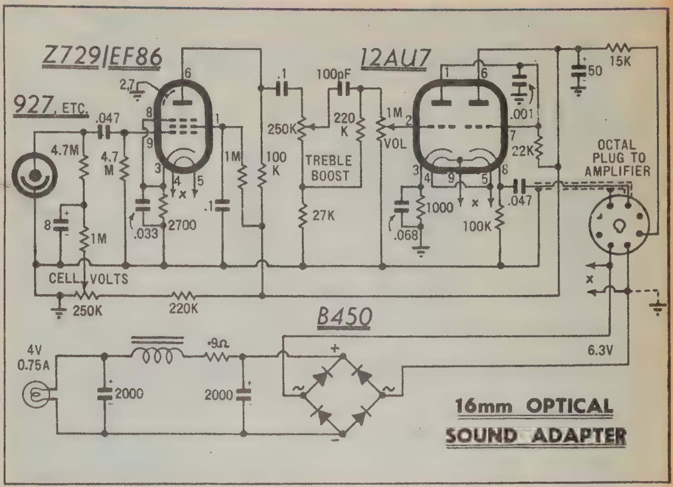
UNIT FEATURES TREBLE BOOST



Main features of the circuit are the provision of adequate treble boost to compensate for losses encountered in sub-standard systems, a DC supply for the exciter lamp, and a cathode follower output to minimise capacitance losses.

is usually about 40 Kc/s. And even if it could, we couldn't hear it!

As can be appreciated, this system involves at least one valve, an oscillator coil and various components for the oscillator circuit. The oscillator uses quite appreciable HT and heater current, meaning that the amplifier power supply must be made larger to cope with the increased drain. The heat dissipation of the oscillator is also appreciable, requiring better cooling and/or more space.

R/F RADIATION

In addition, special precautions must be taken to ensure that high frequency radiation from the oscillator does not find its way into the amplifier circuitry, to overload and cause distortion. This can usually be accomplished by providing adequate shielding, and placing the oscillator close to the exciter lamp, as far as possible from the amplifier circuits.

This system has been used in a number of substandard gauge projectors, mainly because the lamp required may be reasonably small, and does not dissipate much heat.

Let us now turn our attention to the actual amplifier circuitry required for reproduction of an optical sound track. First of all, the photocell has to be supplied with a polarising voltage, usually around 90 volts DC. This may be obtained via a suitable resistance voltage divider from the HT line of the amplifier.

So that the photocell voltage may be set accurately for maximum output from each particular cell, it is desirable to provide an adjustment on the cell voltage. This is usually done by placing a potentiometer in the divider circuit, and placing it in a position for easy screwdriver adjustment. This also allows adjustment in areas where there is a low mains voltage.

The amplifier proper may be built in one of two ways. One is to use a pre-amplifier at the projector to feed signals to a main amplifier, and the other is to build the complete amplifier as part of the projector.

For the present article, we have in mind the reader who already possesses an amplifier of reasonable quality, such as is used for playing records, tape recordings or radio signals from a tuner. The owner of such an amplifier may very likely require only a pre-amplifier for his film projector, in order to use it with the rest of his audio system.

TREBLE BOOST

Accordingly we will concentrate on the design of pre-amplifiers and the problem common to all such systems: that of providing compensation to offset the high frequency losses inherent in film recordings, optical sound systems, and high impedance photocell circuits.

First, the losses in the optical system. These are inherent in the basic principle employed and are a function of the maximum possible film speed on the one hand, and the minimum possible slit size on the other. In practice the film speed is set by the number of frames to be presented per second (normally 24), and the gauge of film. (The 35mm gauge will obviously travel faster, for the same number of frames, than the smaller sizes.) The slit size is determined by purely practical considerations.

In greater detail, and for any given slit size and film speed, there is a frequency which, when recorded on the film, has a complete wavelength in a length of track corresponding to the width of the scanning slit. Obviously, this frequency cannot be reproduced. Even at frequencies approaching half this value, the response of the reproduced signal is reduced in amplitude.

For this reason, amplification circuits used in the reproduction of optical sound signals employ suitable amounts of high-frequency or treble boosting, to ensure that the response fed to the loudspeaker is similar to that originally recorded on the film.

Treble boosting is also required because the photocell is in effect a generator having a very high internal impedance. Thus stray shunt capacitances (often very hard to remove) severely shunt the treble components of the cell output. To help in this regard, photocell leads are kept as short as possible, and means are employed to reduce the impedance level as soon as possible.

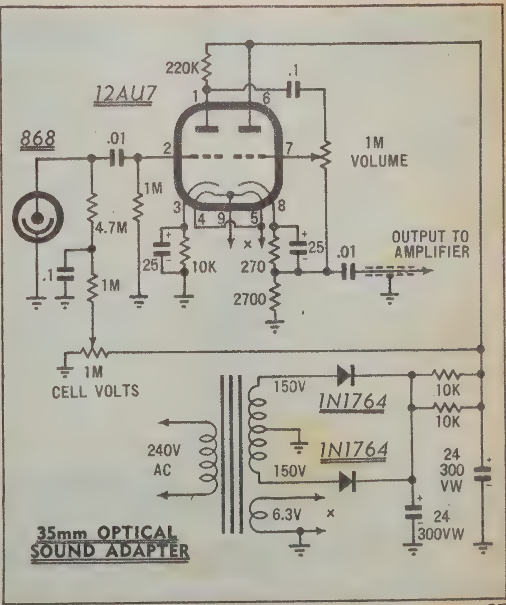
The next point to consider is where in the circuit the treble boost should be provided; whether in the pre-amplifier or the main amplifier. As we shall see, this depends largely on the actual amount of boost required.

In the case of professional 35mm projectors, it is usual to have a normal "flat" pre-amplifier, and to do any com-

* * *

The 35mm adapter may be much simpler, mainly due to wider response of 35mm recordings, etc., and the reduced treble compensation required. In this case the adapter provides no compensation, that in the main amplifier being sufficient.

* * *



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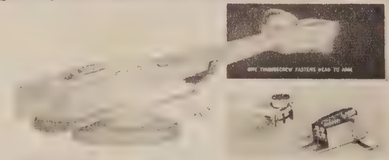

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pensation at the main amplifier. This is mainly because the film speed of 35mm film is much greater than the smaller gauges, there is very little loss in important treble components, and the amount of treble boosting required is quite low.

Figure 1 shows the circuit for a pre-amplifier of this type, intended for use with a 35mm projector. We built this simple unit, and tests show that it is a good performer. It does not incorporate treble boosting as it is intended for use with an amplifier system having a suitable treble boost control (giving about 7 or 8 dB at 8 Kc/s).

PARTS LIST

(16MM ADAPTER)

1	Selenium Bridge Rectifier, Type B450-1-1 or similar.
1	L.T. Choke, approx. 30 mH at 1A.
1	Chassis, front panel and case.

VALVES.

1	EF86/Z729/6BK8/6267.
1	12AU7/12AU7A.

RESISTORS.

1	0.9 ohm 1 watt.
1	1000 ohm ½ watt.
1	2700 ohm ½ watt.
1	15K 1 watt.
1	22K 1 watt.
1	27K ½ watt.
2	100K 1 watt.
2	220K ½ watt.
2	1 meg. ½ watt.
2	4.7 meg ½ watt.
1	1 meg. carbon pot.
2	250K carbon pots.

CAPACITORS.

1	100 pF ceramicon.
1	0.001 mica or styroseal.
1	0.033 mfd 100v paper.
2	0.047 mfd 400V paper.
1	0.068 mfd 100V paper.
2	0.1 mfd 400V paper.
1	8 mfd 300VS electrolytic.
1	50 mfd 450VS electrolytic.
2	2000 mfd 18 VW electrolytics.

SUNDRIES.

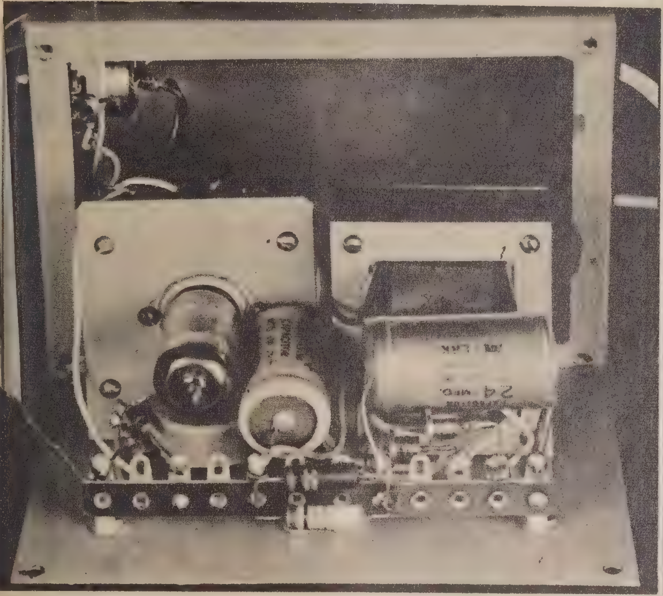
Shielded chassis connector, four pin exciter supply socket, grommets, valve sockets, screws, 2 5-lug tagstrips, 3 8-lug tagstrips, one each of 3-lug and 6-lug tagstrips.

As the circuit shows, the unit is self-contained, with a full-wave power supply using 1N1764 silicon diodes. Photocell voltage is adjusted by a 1 meg potentiometer fitted with a screwdriver slot, and mounted for easy adjustment on the side of the case.

The valve used is a 12AU7 twin triode, as an amplifier and cathode follower. A volume control is fitted to allow the volume to be adjusted at the projector. The cathode follower is used to allow fairly long leads to be used between the pre-amp and the main amplifier without treble deterioration. Leads up to 25 feet were tried on the prototype unit without appreciable deterioration.

This pre-amp uses a small power transformer, and is built into a small steel case suitable for attachment to the front of the projector sound head. No difficulty should be experienced in construction if the photographs are followed. For the prototype, the case was made available from one of our advertisers, R. H. Oxford Pty. Ltd.

CHASSIS DETAILS—35mm UNIT



The 35 mm adapter is housed in a small metal box, with the "chassis" bolted to the front panel. As shown, the panel is lying flat, giving a view above the chassis. The pot. below the valve is the photo-cell voltage control.

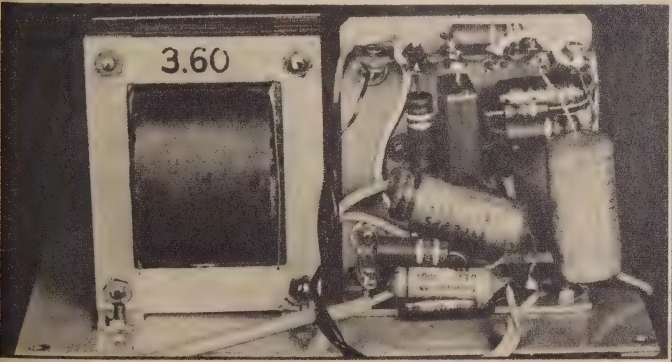
A unit of this type is suitable for 35 m.m. work, but for satisfactory results from the smaller, substandard gauges (16 m.m., 9.5 m.m.), a much greater amount of treble boost is required. It becomes necessary to incorporate considerable amounts of treble boost in the preamplifier.

The second pre-amp, whose circuit is shown in Figure 2, is designed with this in mind. While not self-contained, it is capable of providing up to 30 dB of boost at 5 Kc/s, and produced very good sound with the projector used for testing.

As before, the photocell is supplied from the HT line, with a potentiometer to permit easy adjustment. The signal from the photocell is amplified by an EF86/Z729 valve, which is fitted with only partial by-passing of the cathode resistor to introduce an appreciable amount of treble boost.

Thus at frequencies below that at at which the 0.033 mfd capacitor has a reactance comparable to that of the 2,700 ohm resistor, the gain of the stage is low due to the negative current feedback. At frequencies higher than this, the gain is reasonably high.

The signal passes from the plate of this stage to a treble boost circuit which provides a maximum 18 dB boost at 5 Kc/s. This may be imagined as a voltage divider which is gradually shorted out at high frequencies, having the greatest effect when the pot. slider is at the top of the element.



An underchassis view of the same unit, showing how the minor components are accommodated between two small tag strips and the valve socket.

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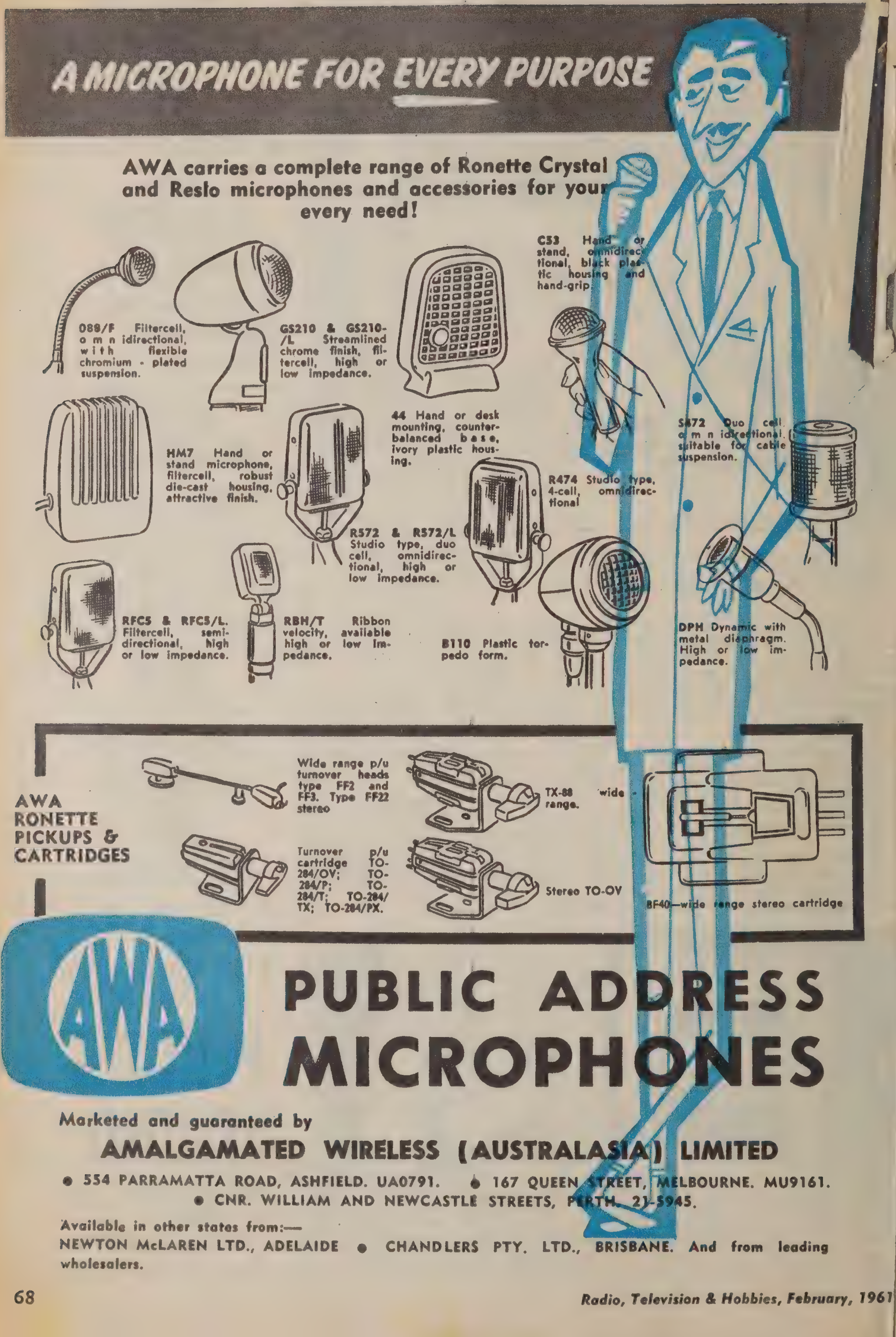

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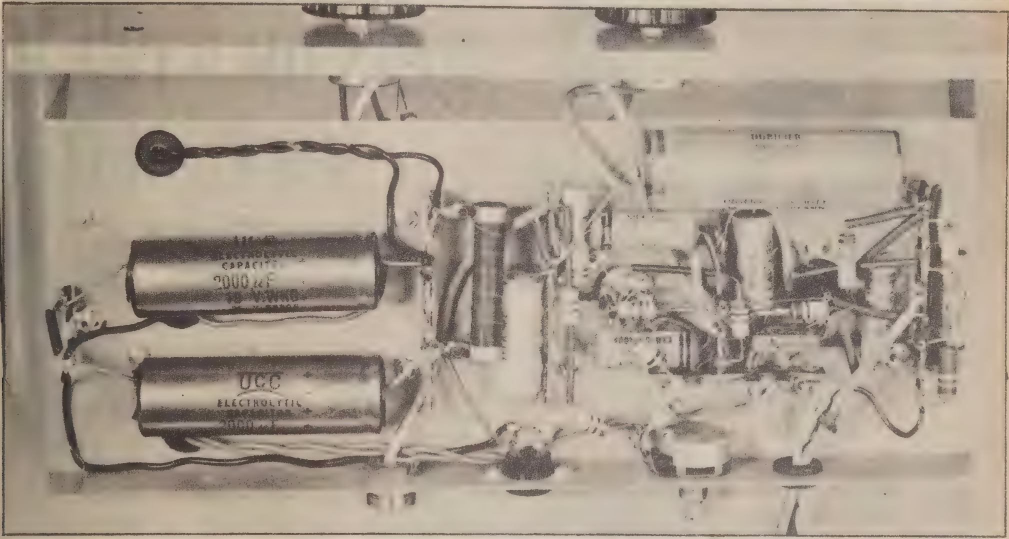
UNDERCHASSIS LAYOUT FOR THE 16mm ADAPTER



An underchassis view of the 16 mm adapter. The valve socket on the right is the 12AU7, with the EF86 near the centre. Note the high value capacitors on the left, being associated with the exciter lamp power supply. Pot. on the rear of the chassis (bottom) is the photo-cell voltage control.

The output from the treble boost circuit is fed to a 1 meg pot. used as a volume control. This controls the amplitude fed to the grid of one half of a 12AU7 valve used as a voltage amplifier. This stage, too, is provided with frequency dependent negative feedback, to increase the treble boost still further.

The output of the voltage amplifier stage is direct coupled to the grid of the other half of the 12AU7 valve, used as a cathode follower. The pre-amp thus has a low impedance output similar to that of the first unit, and may be used with long output leads satisfactorily. The output impedance is around 700 ohms.

You will notice that the grid of the second half of the 12AU7 is bypassed to earth. The object of this is to limit the gain at frequencies higher than the maximum liable to be on the film. Without the capacitor, the otherwise excessive gain makes hiss and noise noticeable.

POWER SUPPLY

It will be appreciated that the treble boost introduced by the two cathode circuits is not controlled by the treble control. Thus even with the control turned fully down there is about 12 dB of boost at 5 Kc/s. However, with most machines the output sounds surprisingly lacking in highs when the treble is boosted by only this amount, so this is in order.

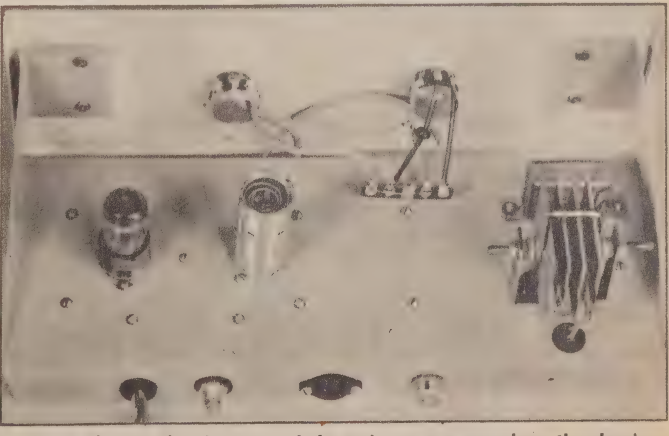
Power for the pre-amp is derived from the main amplifier. The HT drain is of the order of 5 milliamps, while the heater current, which also includes the current drawn by the exciter lamp, is less than 1.5 amps. Most power amplifiers should be able to supply these requirements, which are little more than required by a conventional control unit.

For the particular machine used in our tests, the most satisfactory method of exciter lamp supply seemed to be a rectifier type DC supply. Accordingly, we have shown a supply of this type in the amplifier circuit. If, however, such a supply would not be suitable for your particular machine, or there is already a perfectly good one attached to it, the circuit shown may be omitted.

The circuit shown uses a 4 volt 0.75 amp prefocused exciter lamp. It is supplied with the required direct current from the 6.3 volt heater line via a selenium bridge rectifier and filter circuit. The filter circuit uses two 2,000 mfd capacitors and a filter choke identical to the one used as first choke in the "Power Supply for 10 watt Transistor P.A.," of December, 1959. Small physically, this choke provides enough filtering for this circuit. (The choke is available in at least two brands; National LLA02/11 0and Ferguson CF435. Other brands may be available having similar characteristics.)

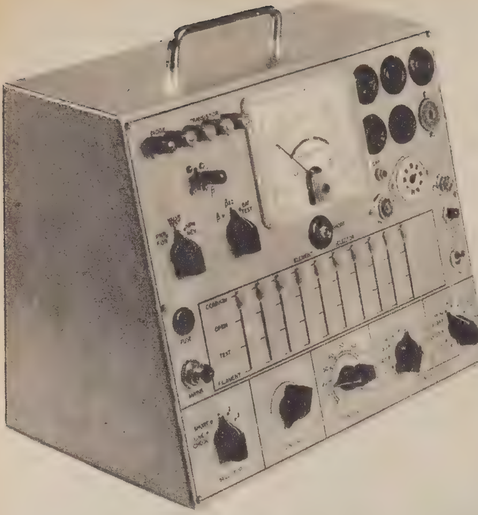
A resistor having a value of 0.9 ohms is placed in series with the choke to drop the output volts to the correct lamp rating. We wound one on a high-wattage high value resistor with resistance wire, but readers may find it easier to wire a 10 ohm half-watt resistor in parallel with a 1 ohm 1 watt type. This will result in a value close to the correct figure.

(Continued on Page 127)



Picture showing the placement of the major components above the chassis. The 12AU7 is on the left, the EF86 near the centre, and the exciter lamp, rectifier and filter choke on the right.

CHECKING PICTURE TUBES ON R.TV & H. VALVE TESTER



Here is our Valve and Transistor Tester, mounted in its special sloping panel case. The panel could be reversed to give a near-horizontal inclination, but this requires some modification to the mounting of the power transformer.

Used in conjunction with out valve tester described last month, this simple adapter allows the current types of picture tube to be tested for shorts and emission, without the necessity of removing them from the cabinet.

THE adapter consists of the two socket types most commonly used in local TV receivers, mounted at the end of a flexible extension lead. The other end of the lead is terminated with an octal plug which is connected into the octal socket on the valve tester in the normal way.

The connections to the eight-pin socket, of course, present no problem, the corresponding pins on the socket simply being wired to those on the plug at the other end.

A problem does arise, however, with regard to the duo-decal socket. To be able to identify all the pins correctly for the purpose of determining element shorts, each pin should have an associated selector switch, numbered according to the pin with which it is connected.

In the case of the duo-decal socket this would normally require that 12 switches be available. However, only 10 switches are provided on our tester and, therefore, some compromise must be made if it is desired to test tubes with the larger bases.

Fortunately, socket connections for the locally manufactured eight-pin and duo-decal tubes have been standardised and it is possible to join the common ELEMENT connections on the duo-decal socket to those on the eight-pin socket rather than connect common pins.

This means, in effect, that the heater, cathode, grid and anode connections on the duo-decal socket are connected to the corresponding element pins on the eight-pin socket, regardless of the actual pin number on the duo-decal socket. It only requires, then, to draw up a short list indicating which element selector switches belong to which pin on the larger socket.

We have included the list in order to show how the connections are made:

Duo-decal.	Octal.	Element.
1	1	Heater
2	2	Grid
10	3	Anode 1
6	4	Focus Anode
11	7	Cathode
12	8	Heater

TYPE	FIL.VOLTS	SELECTOR	SENSITIVITY	1	2	3	4	5	6	7	8	9	CAP
5Y3	5.0	Shorts			F						S		
a1		5	20		F		T						
a2		3	20						T				
6AV6	6.3	Shorts				F	S						
g1		2	15	T		F							
d1		1	35			F		T					
d2		1	35			F			T				
6BW6	6.3	Shorts		S	S		F	S					
g1		2	12	T	O		F						
6BX6	6.3	Shorts		S		S	F	S					
g1		2	10		T		F						
6BY7	6.3	Shorts		S		S	F	S					
g1		2	15		T		F						

A separate wander lead equipped with an ultor clip at one end and a banana plug at the other may be connected from the top cap jack to the ultor of the tube under test, selector switch number 10 then becoming the ultor selector for shorts tests.

The test procedure to be followed for picture tubes is identical with that for valves, as described last month. The heater voltage should first be set and the appropriate heater selector switch placed in position. The line test should be made in the usual way, with the tube already plugged into the adapter.

SHORTS TEST

A shorts test is next in order, and finally the emission may be checked by selecting the grid, normally pin 2, and testing with the selector switch, S5, in the number 2 emission test position.

A setting for the sensitivity control will have to be determined, as in the case of valves, by testing a number of new tubes beforehand and calibrating the sensitivity control accordingly.

Some overseas publications have suggested that certain advantages are to be gained from testing between cathode and final anode, instead of the grid in a picture tube. The presence of gas can be determined by a comparison of the two emission readings taken between cathode and grid and cathode and final anode.

However, due to the relatively large distance between the cathode and the final anode, quite a high potential must be applied between them if any reasonable amount of current is to flow. In our case, the 30 volts used for the emission test is quite inadequate, some 700 volts being required according to figures quoted in the article.

EFFECTS OF GAS

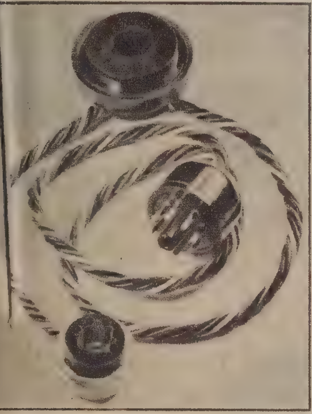
Even if gas is present, its effects can normally be detected due to the poisoning of the cathode emitting material with the consequent loss in emission, and the addition of a much larger transformer to supply the extra voltage is hardly warranted in our opinion, at least, in a general-purpose tester.

It should be mentioned that this adapter may be used with any similar type of valve tester and is not applicable to our design only. The identification of the various pins will be the same regardless of how the element selection is carried out, whether by rotary or lever switches or press buttons. The adapter may be plugged into the existing octal socket and the list previously mentioned used to identify the particular elements.

With the addition of this adapter our valve and transistor tester becomes a very versatile instrument indeed and will provide test facilities for those engaged n almost any branch of the electronics dustry.

So much, then, for the adapter. Re- rring to the picture at the head of the ticle, our valve tester can be seen oused in its new case.

We have chosen this particular style being suitable for bench mounting, t there is no reason why the panel



This picture tube adaptor requires only a few minutes work to construct and is a very worthwhile addition to our Valve and Transistor Tester.

could not be inverted and the case laid on its back. If this method is preferred, he transformer position may have to e altered somewhat to clear the inside op edge of the case.

As mentioned last month, plans are well in hand for the production of a unched and etched panel and both case nd panel will be available through nor- nal sources in due course.

We omitted to mention last month he transformer filament tap voltages and we have, therefore, listed them in table orm below. You will notice that the ctual tap voltage is listed as well as he tolerance range that it covers.

An obvious problem which faces any- one who constructs their own valve tes- er is that of recording the data on in- dividual types.

POWER TRANSFORMER FILAMENT TAPS.

Tap.	Cal.
1.4V	1.4V
2.0V	2.0V
2.5V	2.5V
3.3V	3.3V
4.0V	4.0V
5.0V	5.0V
6.3V	6.3V
7.5V	7.5V
12.5V	11-13V
15V	14-16V
18.5V	17-20V
23V	21-25V
28V	26-30V
33V	31-35V
39V	36-42V
47V	43-51V
56V	52-60V
66V	61-71V
78V	72-84V
92V	85-99V
109V	100-117V

(Continued on Page 127)

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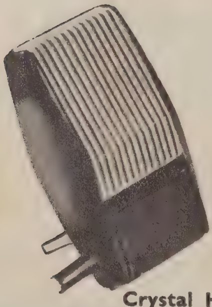
Crystal Torpedo Microphone: Streamlined appearance, high output, excellent directionality, minimum feedback and anti-fray flexible connector are features of this model. Used as a band microphone, with neckband; on the desk with detachable stand (as illustrated). *Retail Price* **75/-**. *Stand* **25/-**.



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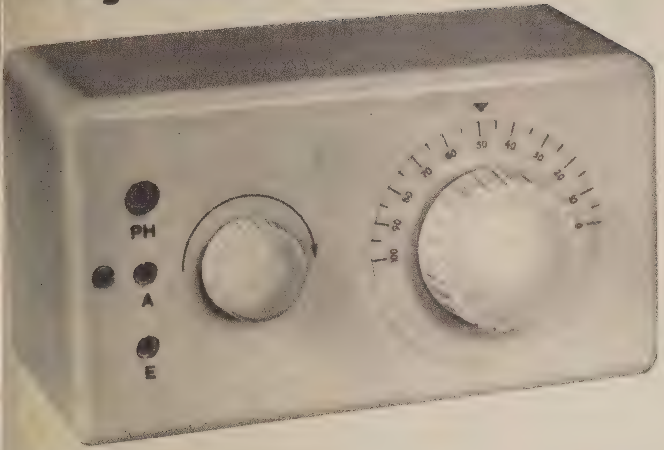

The set looks quite handsome in its little cream bakelite cabinet, with matching knobs. Note the holes through which access is gained to the aerial, earth and phone connectors.

A One-Transistor Broadcast Receiver

No matter how many small sets we describe in these pages over the years, there always has been—and probably always will be—a very keen interest in them. We are continually receiving requests from readers concerning circuits or kits of parts, either from the son who wishes to construct his "first", or from father, wishing to take up his old hobby again.

By John Davidson

THERE is nothing unusual or difficult about this set. On the contrary, we have deliberately tried to avoid difficulties, which might become a source of discouragement. At the same time, it is quite neat in appearance and would not be out of place either in the son's room or alongside father's bed, so that he can listen while everyone else wants to sleep.

In designing the set, also, we have allowed for expansion, to increase both its "tutorial" value and its electrical performance.

VALVE CIRCUITS

When a circuit is designed around a thermionic valve, as were all our earlier regenerative or Reinartz sets, it is necessary to supply filament and high tension voltages, which have to be obtained either from large and relatively expensive batteries or from the 240-volt mains, via an appropriate rectifier.

This latter arrangement is often of concern to parents, because of the possibility of their enterprising offspring receiving a dangerous shock.

The big advantage in using a transistor is that it has no filament to heat and therefore requires no filament battery. The only voltage supplied to it is obtained from a small, inexpensive battery which could hardly be called "high tension."

Thus the transistor, with its low voltage supply and low current drain, enables us to present this simple and relatively inexpensive small set. As with any regenerative set, it will produce excellent results, if carefully adjusted.

The decision to feature another small set arose largely out of a discussion between members of the staff and a few advertisers interested in this market. A number of highly practical suggestions, as well as a few seemingly impractical ones were put forward concerning its design.

The circuit takes the form of a one transistor regenerative receiver which, in itself, is by no means new, having been used several times in earlier issues.

It was recommended that ferrite material be used in the coil, either the toroid as used in one of our previous designs, or a ferrite rod.

Ferroxcube material allows a very efficient coil to be wound in a comparatively small space, which is an obvious advantage in a small set.

The toroid was ruled out, due to the difficulty which some beginners seem to have had in winding this type of coil. Thus the use of a ferrite rod, commonly referred to as a "loop stick," was decided upon, with the additional advantage that it can serve as an aerial in good signal localities. In fact, the effectiveness of the loop stick aerial is such that one manufacturer has given it the name of "signal magnet."

Fortunately, there is no need for the performance of the set to be limited by the amount of signal which can be picked up by the ferrite rod aerial coil. It is entirely practical to add a primary winding to the coil, to allow connection of an external aerial and earth, giving extra flexibility in use.

MATRIX BOARD

It was also suggested that the components be mounted on one side of a strip of matrix board, sometimes referred to as punched bakelite, and the wiring run on the underside, giving a printed circuit appearance to the set.

Another suggestion was that we use a small earpiece of the type supplied with a number of commercial transistor sets.

A few inquiries established that there were two types available at the moment, one a low impedance magnetic and the other a crystal unit. Unfortunately, neither of these provides a real substitute for the conventional headphones, which usually have an impedance of from 2,000 to 4,000 ohms.

In these circumstances, we have been obliged, rather reluctantly, to assume the use of conventional headphones though not entirely ruling out the miniature earpieces.

In some cases, the advantage of low cost and small size of the earpieces could out-weigh the expected loss in sensitivity due to unsuitable impedance. More will be said about this later in the article.

A suitable plastic case, which had come to light earlier, was brought into the picture and we immediately began to visualise the finished product as you see it in the photograph. The plastic case is a somewhat larger version of the one we have used for other projects, and should be available through the same sources.

CONVENIENT SIZE

It transpired that the components and wiring could, in fact, be concentrated on to a piece of matrix board, as suggested, of convenient size to slip neatly into the box, and leaving room for a flat-type 4½-volt torch battery. A couple of matching knobs and a simple dial scale complete the picture.

Heart of the circuit, as we mentioned earlier, is a transistor, which rectifies and amplifies the incoming signals, as selected by the coil and tuning capacitor. The transistor actually performs three functions, which can be considered separately.

The first is that of the base and emitter acting as a diode to detect the in-

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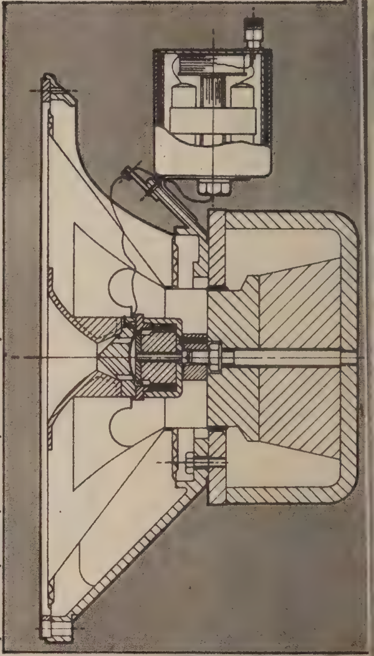
Impedance:	15/16 ohms.
Coil Diameter:	3" Bass and Mid-range 1" (Aluminium) H.F. Pressure Driver
Electrical Crossover:	5,000 c.p.s. twin half section L.C. network 12 db/octave
H.F. Balance Control:	constant impedance wirewound L-pad, 0-15 db.

TYPE	SIZE	POWER HANDLING CAPACITY	FUNDAMENTAL RESONANCE	MAGNET WEIGHT	TOTAL FLUX	BAFFLE HOLE	¼" BOLT CIRCLE DIAMETER
412	12	20 watts	35	3½ lbs.	240,000	11"	11¾"
415	15	20 watts	25	3½ lbs.	240,000	13"	14 9/16"
615	15	25 watts	25	6 lbs.	308,000	13"	14 9/16"



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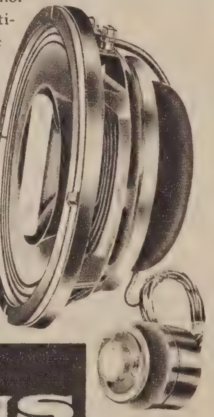

SPECIFICATIONS

Frequency Range: 40 — 20,000 c s

Fundamental Resonance: 45 c s

Max. Power Handling Capacity: 10 watts, 20 watts U.S.A.

Total Flux: 178,000 Maxwells

Voice Coil Diameter: (Bass and Mid-range) 3"

Voice Coil Diameter: (H.F.) 1"

Impedance: 15 ohms at 400 c/s.

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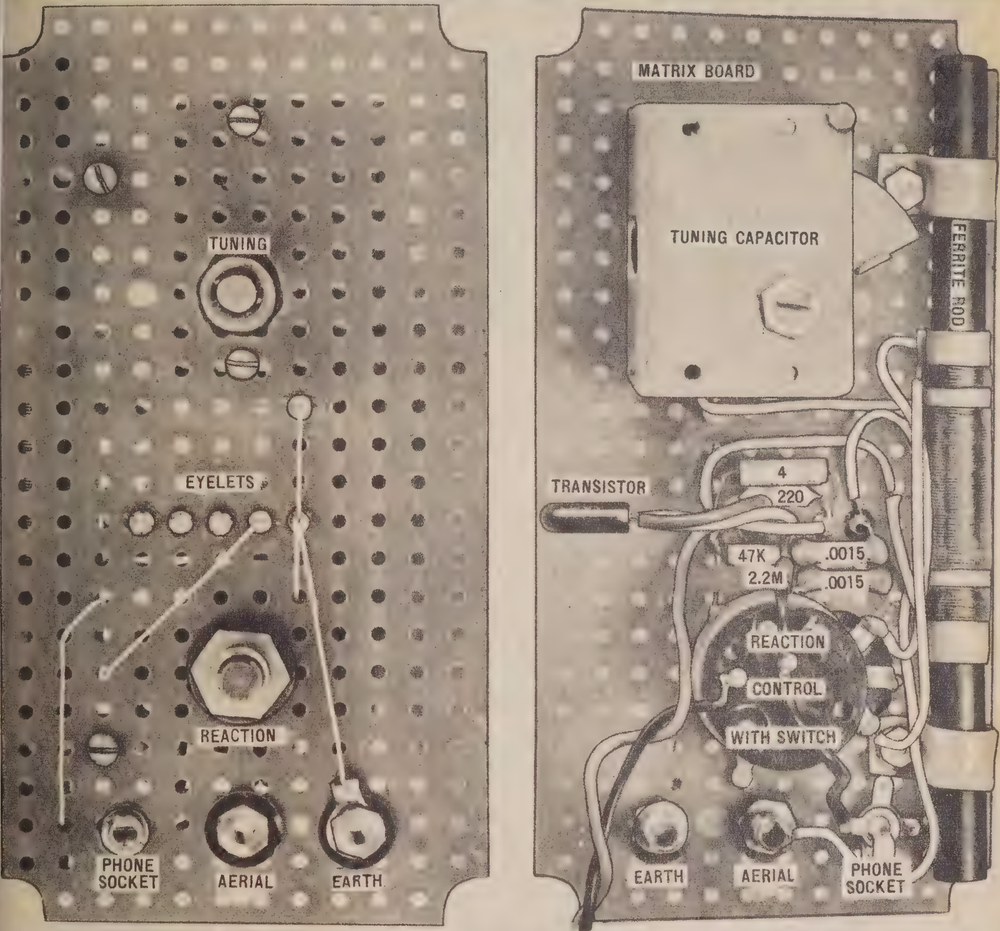

Reproduced full size and outlined by our artist for extra clarity, these two pictures show both sides of the assembly board. Although pre-punched bakelite was used in the original, plain bakelite or perspex would do equally well, with the necessary holes drilled.

coming radio frequency carrier wave. The audio frequency modulating components, which were impressed on the carrier wave at the transmitter, are now developed across the 47K resistor, serving as the detector load.

The function of the detector, in demodulating the incoming modulated carrier wave is the same as that performed by the lead sulphide crystal and "cat's whisker" in early crystal sets or the germanium diode which the beginner of today would use.

In the crystal set, the detector load is provided by direct connection to a pair of headphones and the only energy available to actuate the diaphragms is that collected by the aerial.

The second function of the transistor is to amplify the detected signal. The circuit thus employs only one stage of signal amplification but we hope to describe the addition of another stage in the next issue.

The voltage divider formed across the battery by the 47K, detector load and the 2.2Meg resistor, together with the 220 ohm emitter resistor, sets the bias on the transistor. In this case a compromise is necessary, because we are operating the transistor both as a rectifier and an amplifier in an attempt to obtain the greatest overall efficiency.

REGENERATION

The third function is to amplify the incoming radio frequency signals, enabling a fraction of this amplified signal to be coupled back into the tuned circuit. Provided that the radio frequency energy fed back is in phase with (or assists) the received signal, positive feedback or "regeneration" is produced. When correctly adjusted, this reduces or makes up for, the losses in the tuned circuit and also the energy lost during detection.

Regeneration (sometimes called "reaction") improves both the amplification and the selectivity and allows quite surprising results to be obtained from a single transistor—or valve in the case of a valve type set.

The amount of regeneration is vital, however. Too little and the performance may not be boosted sufficiently; too much and the detector will commence to "oscillate" or generate a signal of its own accord.

We then have two frequencies, the frequency of the incoming signal and that of the oscillating detector. These produce a heterodyne note which appears as a continuous whistle, mixed up with the required signal.

Optimum performance is normally obtained with the detector adjusted just short of active oscillation.

The regenerative effect is produced by a few turns of enamelled wire wound on the ferrite rod, near the tuned circuit and connected in series with the collec-

METROPOLITAN RADIO SUPPLIES

640 KING STREET, NEWTOWN, N.S.W.

Brand new AMPLIFIERS *At low low Prices*

R.F. AMPLIFIER

A high-powered unit suitable for use with either No. 11, 19 or 22 sets. Approximate output is 30 watts and it's ideal for conversion into a 12 volt public address system.

£5

(5/- Delivery to Rail)

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240 volt AC relay, 50/-; 12 volt 100 ohm sperry sealed relay, 35/-; Thermal timed delay relay, 10 volt, 50/; clockwork timed delay, 25/-; sealed relay, 25/-.

3,000 type: Wide range of coil resistances from 15 to 50,000 ohm. Prices from 10/6 to 15/-.

600 type: 200 ohm, 250 ohm, 600 ohm, 10/6 each.

Large range of other types from 6 to 250 volt and wide ohm selection and contact combinations, 10/6 to 70/-.

Call and select please!

RECORDING TAPE

1,200ft twin sided Irish tape wound on to standard 7in plastic spools.

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(Post 3/6)

PORTABLE TRANSMITTER

Contains many useful parts. Valve induction coil, several resistors and condensers and a 6ft telescopic aerial.

7/6

(Post 3/6)

MAINS FILTERS

Complete with lead, plug and socket.

35/-

(Post 3/6)

LINES FILTERS

28/-

(Post 4/6)

STEREO CONTROL PANELS

£5/-/-

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Q-Plus ALIGNING TOOL

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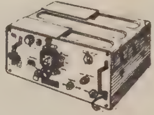
(Post 6d)



VALVES

1A5	7/6	6R7	12/-	803	30/-
1K5	4/6	6U7	5/-	830B	10/-
1Q5	1/6	7C4	5/-	7193	1/6
6AG5	6/9	12A6	7/6	EF50	1/6
6G6	12/6	217C	150/-	1H6	5/-
6SF75	7/6	809	19/6	1M5	4/6
6X5	9/6	954	1/6	6AB7	6/-
7C7	2/-	AV11	1/11	6C4	5/-
12C8	10/	1D4	6/6	6L7	12/6
328A	2/6	1K7	3/6	6SJ7	10/-
815	29/6	1T4	4/6	7A8	5/-
958A	1/11	6AJ5	9/6	7W7	2/6
EC54	4/6	6J7	4/9	71A	10/-
1J6	7/6	6SH7	2/3	807	11/6
1P5	1/6	7A6	5/-	832A	35/-
6AC7	2/6	7E5	5/-	9006	7/6
6C8	7/6	12H6	7/6	EL32	15/-

(Post 9d first valve, 1d each additional valve.)

FERRITE ROD AERIAL

These rods replace the normal aerial coil with external aerial and improve selectivity and sensitivity greatly.

Priced ridiculously low at only 17/-.

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ALL WAVE NOISE REDUCING UNIT

Famous Aegis aerial noise reducing unit consisting of two matched transformer units, 7/22 Copper aerial, twin plastic lead in earth return wire and necessary insulators. Complete diagram and instructions for installation are printed on the inside of the box.

£7

(Post 4/6)

COILS

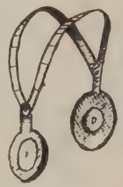
455 KC. RFT, 16 to 50: 13 to 42: 40 to 110. Short wave, oscillator and aerial coils.

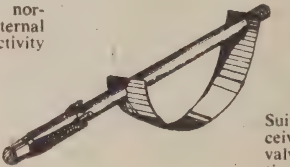
5/- each

RFT No. 3 maximum selectivity.

10/- each

(Post 1/- each)





SPECIAL TUNING KNOB

⅜ inch bore knob with 3 inch skirt and 5 inch scale calibrated from 0-100. Also has edge fitting, fine clear plastic dial indicator and fine tuning knob.

A Bargain at just 15/-

DUAL WAVE COIL UNIT

Complete with circuit and instructions for 16 to 50 metre Broadcaster.

35/-

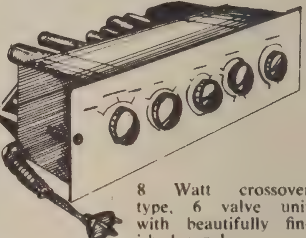
WOBBULATOR

For TV testing, frequency modulator construction.

50/-

(Post 3/-)

STEREO AMPLIFIER



8 Watt crossover type, 6 valve unit with beautifully finished panel.

£20

(5/- Delivery to Rail)

HEADPHONES

Brand new, imported, low impedance headphones, suitable for use with recording tape, etc. **17/6 pair.** High impedance headphones for crystal sets, etc. **27/6 pair.**

(Post 3/6)

TEST PRODS

8/6 pr.

(Post 1/-)

TV TURRET TUNER

Suitable for normal TV Receivers, Complete with valves, ready for installation.

£7/10

(Post 3/6)

6 VOLT ELECTRIC MOTOR

Imported direct from America. These motors run from 6 volt D.C. and are suitable for operating car fans and the like.

35/-

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22 GAUGE WIRE

All purpose insulated, plastic covered wire for bells, telephones, modelling, etc., etc. 3,000ft wound on sturdy wooden reel with detachable carrying and unreeling handle.

Only 7/6 per reel

5/- delivery to rail.

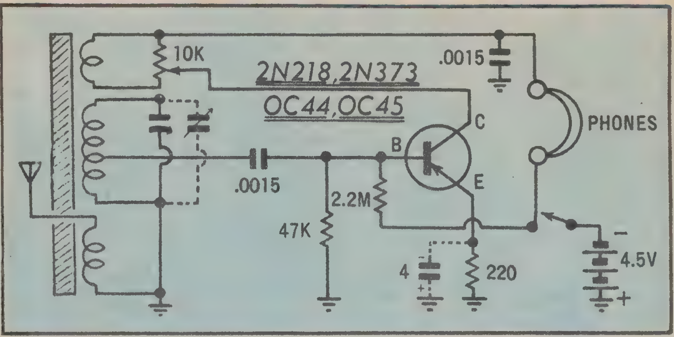
Mail Orders to 640 King Street, Newtown. Sorry, no C.O.D.

ALL PERTH INQUIRIES TO

ANDYS

328 Murray Street, Perth, W.A. Please note that prices are slightly higher in W.A. due to extra transport charges.

CIRCUIT OF ONE-TRANSISTOR SET



The circuit is rapidly becoming as conventional as the "Reinartz" circuit of the valve era. No less important than the circuit is the adjustment and operation.

or and the phones. Control of regeneraion is provided by the 10K potentioneter shunted across the reaction windng.

Minimum regeneration is present when he moving arm of the potentiometer carries the collector directly to the end of the "reaction" winding connecting to he phones. Maximum regeneration occurs at the other end of the winding.

It is quite essential that the coil be wound as per the instructions given later and that it be connected into circuit the right way round. Reversing the winding will cause degeneration and loss of gain instead of the required regeneration.

PARTS LIST

1	**piece matrix strip 12 hole x 6in.**
6	**eyelets for matrix strip.**
1	**plastic case. 6⅜ in x 3½in x 2¾in deep.**
1	**transistor OC44, OC45, 2N218, 2N373, etc.**
1	**single-section miniature tuning capacitor 415 pf (approx.).**
1	**50 pf. trimmer capacitor (optional, see text).**
1	**ferrite rod ⅜ in x 5in or longer (see text).**
1	**10,000 ohm carbon potentiometer with switch.**
2	**.0015 mfd mica or ceramic capacitors.**
1	**4 mfd low voltage electrolytic capacitor (optional, see text).**
1	**220 ohm, ½ W resistor.**
1	**47 K, ½W resistor.**
1	**2.2 Meg, ½W resistor.**
1	**4.5 volt battery.**
1	**pair high impedance headphones or earpiece (see text).**
1	**miniature phone socket.**
2	**banana sockets.**
1	**small knob.**
1	**dial knob.**

SUNDRIES

Approx. 10ft of 26 B & S enamelled wire. Tinned copper wire, plastic spaghetti, bolts and nuts, scrap material suitable for back and battery clamp.

The .0015 mfd capacitor across the phones provides a low impedance bypass at radio frequencies, and helps to ensure stable operation.

Without this capacitor, there is a risk that the phone cords will become "hot" at high frequencies, affecting the regeneration as they sway about.

To be able to achieve smooth and reliable regeneration, a transistor must be chosen which is capable of amplifying signals up to a frequency of at least 1.5 megacycles. We actually used an OC44, though a number of different types satisfying this requirement have been recommended in previous articles and are listed below for the convenience of any reader, who may have one of them already on hand:—

OC45, 2N218, 2N373, 2N252, 2N308 and 2N309.

BIAS RESISTOR

One earlier article describing a similar project suggested that slightly better performance could be achieved if the 2.2 megohm forward bias resistor was reduced in value to 1.0 megohm, when using types 2N252, 2N308 and 2N309.

In the circuit, the 4 mfd bypass on the emitter is shown dotted. In some cases, the set will be found to perform slightly the better with it in circuit. In others, it may produce a tendency towards "fringe howl," a rather rough howling noise at the point of oscillation, as distinct from the smooth heterodyne whistle which varies in note as the set is tuned across the station.

As mentioned earlier the ferrite rod enables us to obtain a very high Q in the tuned circuit which enables a substantial radio frequency signal to be developed across it at the natural resonant frequency.

The base of the transistor is tapped down towards the earthy end of the coil to obtain the maximum transfer of energy. The .0015 mfd coupling capacitor has a high reactance to audio but low reactance to radio frequency.

As you can see, the phones are connected directly in the collector output circuit.

Coming to the construction, the strip of matrix board we used for the mounting of all components, excepting the battery, is 12 holes wide and 6 inches long. The four corners were filed away to enable it to fit neatly into the back of the plastic case.

The hole for the single-gang tuning capacitor shaft was made large enough for this component to mount as close as possible against the back of the board. It is held rigid by two small metal thread screws, making use of the tapped holes in the capacitor frame.

Make sure, by the way, that the screws do not press against the fixed plate assembly.

The regeneration control is mounted through a 3/8-inch hole, 2½ inches to the left of the tuning capacitor shaft.

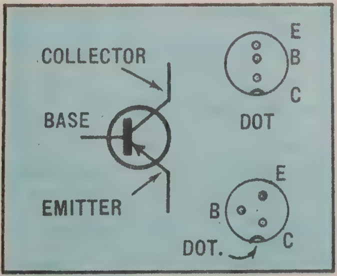
The line-up of sockets along the left are from the bottom, "Earth," "Aerial" and "Phones." Earth and aerial sockets are of the banana type and the phone socket is one of the miniature types, normally used for an earpiece.

MOUNTING DETAILS

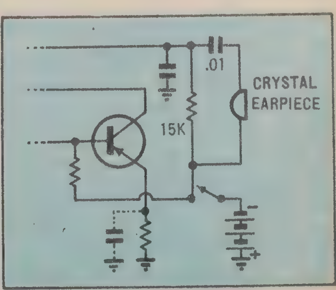
Holes have to be drilled in the plastic case to correspond with those in the matrix board which, when fully wired, is held against the front of the box by two ½-inch countersunk screws. To enable the phone plug to connect properly into its socket this hole must be made large enough to take the full diameter of the plug.

All the small components including the transistor are anchored to five small plated eyelets of the type used for solder contacts. These eyelets are lightly riveted in a single line between the tuning capacitor and the regeneration control.

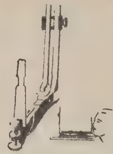
The lower eyelet is the earth contact



These diagrams show the lead arrangements for common low-power transistors. Do not clip the leads unnecessarily or apply excessive heat when soldering.



To use a crystal earpiece, the circuit has to be amended as shown, with a resistor added to carry the collector current.

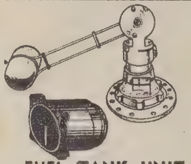


INCLINOMETERS

Will measure angles. Ideal for builders, farmers, etc., for elevation, depression, drainage etc.

£7/10/- Each

Post, N.S.W., 7/; Int., 9/6.

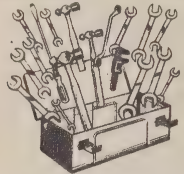


FUEL TANK UNIT AND GAUGE

Contains sender and receiver units. Used in place of Selsens as direction indicators.

15/- Pair

Post, N.S.W., 3/; Int., 6/.



SUPPLY RECTIFIER UNIT No. 13. NEW

INPUT. A.C.V. 240, 230, 220, 210, 200v. Also 100, 110, 120, 130v. OUTPUT D.C.V. 24v D.C. Tapped to give 2at 12v D.C., 3 amps output. Voltage output can be increased in small steps to 28v D.C.

£12/10/- each

Freight payable at nearest Attended Railway Station.

NATIONAL TRANSFORMERS

For Scope soldering irons, new. 240V A.C. in 3.3V out at 30 amps.

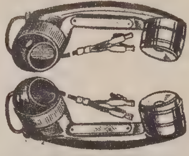
38/6 each

Post, N.S.W., 7/; Int., 11/.

LENSES AND PRISMS

4¼-inch concave reflecting mirror.	12/6.
Eyepiece, low power, 1¼in F.L.,	£3 ea.
Eyepiece, high power, 5/8in F.L.,	£4/10/ ea.
Right-angle Prism, 2¼in square face	£4/10/-
Small Erecting Prism	£1 ea.
Large Erecting Prism	25/ ea.

Add Postage.



TELEPHONE HANDSETS

NEW SOUND POWERED

No battery required. Ideal television installation intercom., field telephones, etc.

55/- ea.

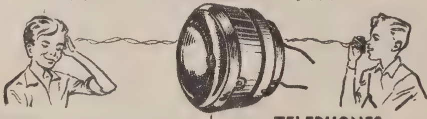
or £5 a pr. Post 5/-, Int. 7/6.

SPECIAL QUALITY TOOL OFFER

1 Set 6 SAE Set Spanners, sizes ¼in to 1in.
1 Set 6 WHIT. Set Spanners — 1/8in to 9/16in.
1 Ring Spanner, ⅝in x 11/16in.
1 Open-end Ring Spanner. 11/16 x 13/16.
1 Ring Spanner, 11/16 x 13/16.
1 Tube Spanner, 14mm x 18mm.
1 6in Shifting Spanner.
3 BALL PEIN Hammers — 8oz, 16oz, 24oz.
1 pair 6in PLIERS.
1 15ft tow-rope with spliced loop and steel hook.
1 METAL TOOLBOX, 19in x 8in x 7in.

THE LOT FOR £6/15/6

3/- Cartage to Rail.
Freight payable at nearest attended Railway Station.



VOLTMETER

0 to 15 volt DC and 0 to 220 volt DC, with probes. In waterproofed Canvas Case.

33/6 each

Post: 3/; Int., 4/.

OIL PRESSURE GAUGES

New. Suit cars, trucks, boats, stationary motors, etc. 0-150lb per sq. in.

£1 each

Complete with tubing.
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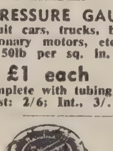

P8 COMPASS

Liquid filled. As new. Ex-R.A.A.F. Ideal for small boats, etc.

£3/19/6 each

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TELEPHONES

Sound powered, can be used as microphone or receiver. New.

38/6 Pair

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Type 2C8388. No. 24. Plug-in coils. 5 to 11 Mcs. with power supply and speaker.

£19/10/-

AIR SPEED INDICATORS

NEW.

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PERISCOPES

10in x 4in x 1¼in. Contain two front silvered mirrors, 3½in x 1¼in x 1/8in.

12/6 each

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29/6 ea.

NEW.

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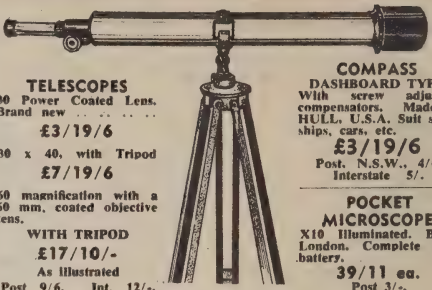


TELESCOPES

30 Power Coated Lens. Brand new . . . .

£3/19/6

30 x 40, with Tripod

£7/19/6

60 magnification with a 60 mm. coated objective lens.

WITH TRIPOD

£17/10/-

As illustrated

Post 9/6. Int. 12/-.

COMPASS

DASHBOARD TYPE. With screw adjusting compensators. Made by HULL, U.S.A. Suit small ships, cars, etc.

£3/19/6

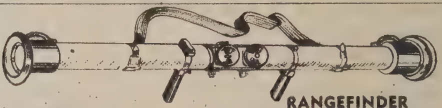
Post. N.S.W., 4/6; Interstate 5/.

POCKET MICROSCOPE

X10 Illuminated. Beck, London. Complete with battery.

39/11 ea.

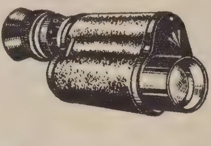
Post 3/-.



RANGEFINDER

Barr and Stroud Tubular Type. 4 ft length MK. V.

£12/10/-



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8 x 30. Ideal for Races, Football or General Viewing. This is the Monocular that is used as a telephoto camera lens. With Leather Carrying Case **£5/19/6**

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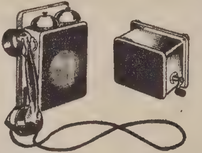
BALL BEARING.

1 3/8in diam., ¼in shaft, 30/ doz.
1¾in diam., ¼in shaft, 42/ doz.
2 3/8in diam., 3/8in shaft, 54/ doz.
3½in diam., 3/8in shaft, 66/ doz.

Add postage.



TELEPHONE SETS

Ex. P.M.G. Wall-type. Complete with Magneto Box. Battery operated. Ideal long distances.

£4/15/- each or £9 pair

Freight payable at nearest attended Railway station.

Dashboard COMPASS

Small ships. Pioneer American. Liquid Damped with Light. Also suit as car compass.

£9/17/6

CHASSIS

RT24/APX2 or B/APX1 15 miniature seven-pin ceramic valve sockets and covers, trannies, etc.

45/- each

WIRE STRAINERS

Ideal for fencing, aerial cables, etc. Suitable for wire up to 5/16in dia. 37/6 per set.
Post N.S.W., 7/. Interstate 9/6.

TRANSFORMER AND RECTIFIER UNIT

New U.S.A. 240 A.C. 110-115V. Unit operates at 110v-115v D.C. at approximately ½ amp. out. from 240 V.A.C. in.

ALSO HAS A STEPDOWN TRANSFORMER 240 V.A.C. 100-115 V.A.C. AT 5.33 AMPS.

The unit has three outlets for A.C., two outlets for D.C., and will operate all voltages input around 240 V.A.C. and 110 V.A.C. has many input tappings, also has 110V rectifier choke and two 500 M.S.D. capacitors. Stepdown transformer 240V to 110V A.C. £10 or

Complete Unit £12/10/

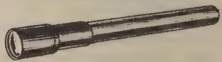
Freight payable at nearest attended Railway Station.

COMPLETE TRANSMITTER NO. 153

A.W.A. type J51050 comprising R.F. unit, power control and minor rectifier unit and main rectifier unit, with spares. 100 watt R.T. 300 watt C.W. Crystal controlled 2 to 20 megs. with power supply. 110 or 240 volt A.C. 50 cycle. New. Will transmit over 500-mile range daytime. World range night. Original cost £2,000. Heavy-duty wide band aerial included.

£125 COMPLETE

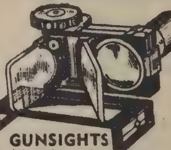
SECOND HAND £75 each



TELESCOPIC SIGHT

Ideal Rifle or Dumpy Level Sight.

47/6 Post, N.S.W., 3/; Int., 4/.



GUNSIGHTS

Contain these lenses:
1 lens 1in Focus, ½in diam.
1 Lens 1 11/16in Focus, 1¼in dia.
1 Air Spaced Lens, 1¼in diam.
1 Filter Lens, 1 Graticule.
1 Lampholder.

18/6 each Post: N.S.W., 2/6; Int., 3/.

DEITCH BROS.

70 OXFORD STREET, SYDNEY
Between Crown and Riley Streets, City.

and tinned copper wire is used for strapping together the earth terminal, the rame of the capacitor and the case of he regeneration potentiometer.

The next three eyelets terminate the ransistor collector, base, emitter respecively, and if you find it necessary to remove the transistor at any time, keep in mind that the dot is towards the bottom.

Eyelet number five is used to anchor he tuning coil tap and .0015 mfd coupling capacitor.

A sixth eyelet was also provided near he tuning capacitor frame.

SENSITIVE TO HEAT

At this stage we might mention a couple of pointers on the handling of ransistors for those of you who are unfamiliar with their use. These devices are ensitive to heat and some care should be exercised when soldering them. For his reason we recommend that the leads be left at their full length and soldered nto circuit last of all, with the heat applied for the minimum of time.

It is also important to remember that he positive terminal of the battery is connected to the earthy side of the circuit, not the other way round, as in most valve receivers.

Spanning along the top of the board s the ferrite rod aerial held by two straps of large diameter spaghetti. The rod we used was the standard type used for aerials, of about 3/8-inch diameter and 8 inches long. The length was reduced to 5 inches by filing a V-slot around the rod and the waste lightly snapped off.

The coil former is made from a piece of thin cardboard, with a suitable adhesive applied to a portion of one side, wrapped around the rod for about two turns. Allowance must be made for the former to slide along the rod to enable the inductance of the coil to be varied if necessary.

COIL DETAILS

The tuned winding consists of 54 turns of 26 B & S enamelled copper wire tapped at 16 turns. The tap can be soldered in the clear by passing this turn over the top of a narrow strip of cardboard or a match.

The regeneration winding consists of 7 turns of 26 B & S, spaced approximately 1/8-inch from the active end of the tuned winding.

Some effort should be made to obtain and use 26 B & S gauge wire or 27 SWG, not because other gauges will not work but because the use of thinner or thicker wire will affect the length of the coil and possibly involve you in adjustments to get things just right.

The aerial winding, in our set, consists of 10 turns of 26 B & S wound approximately 1/8-inch from the tapped or earthy end of the tuned winding. All coils are wound in the same direction and the ends can be fixed by coil lacquer or nail polish.

A handy hint is to pass the two adjacent turns at each end through a scrap of insulating sleeve, to hold them firm while the cement dries.

Assuming that the coils are all wound in the same direction, connection to them must be made in the order as indicated on the circuit. Thus the outer connection of the aerial primary goes to earth, the inner to aerial. Then comes the earthed end of the tuned winding, the active end going to the fixed gang plates. Finally

Continued on page 123.

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BX4440, BX4587

UNDERSTANDING TUNNEL DIODES

Did the article on the Tunnel Diode which we featured in the November 1959 issue leave you somewhat up in the air? If it did, read on—we might be able to clear up a few points on its operation and uses for you. This article is intended as a preliminary discussion for a practical project in the near future.

By Jamieson Rowe

AS the name would suggest, the Tunnel Diode is a diode, having only two electrodes and two connections. It is not a thermionic (valve) diode, but a semiconductor, like the familiar germanium and silicon junction diodes used nowadays as detectors and rectifiers. A sort of second cousin to the transistor, if you like!

The most common of present tunnel diodes is the germanium tunnel diode, so we will use it as the subject of our discussion. This tunnel diode is rather like the regular germanium junction diode, but with some rather significant differences, as we shall see in a moment.

As you possibly know, a normal germanium junction diode consists of a quantity of "p-type" germanium and a quantity of "n-type" germanium, side by side in the same crystal structure.

P-TYPE

By p-type germanium we mean that the crystal is not pure germanium, but has a number of atoms of another element, called an "acceptor" impurity, occupying some of the positions in its crystal lattice structure. An acceptor impurity (which in the case of germanium may be boron, aluminium, gallium or indium) is one which has only three electrons in its outer shell, as against the four of germanium.

Because acceptor atoms have one less electron in their outer shell, we find that a piece of p-type germanium has a number of electron vacancies or "holes" scattered throughout it. These holes can move about in the crystal from atom to atom when given slight amounts of energy, for instance from thermal (heat) irradiation.

(It should be noted that, although the holes move, the parent impurity atom which produced them remains anchored in the crystal structure. Nor can the nature of the impurity atom change, since it is determined by the nucleus.)

N-TYPE

Conversely, by n-type germanium we mean that the germanium has a number of atoms of a "donor" impurity occupying positions in its crystal lattice. A donor impurity (which in the case of germanium may be phosphorus, arsenic, or antimony) is one which has five electrons in its outer shell, as against the four of germanium.

Because donor atoms have one more electron in their outer shell, we find that a piece of n-type germanium has a number of very loosely bound electrons scattered through it. At normal temperatures, these electrons move about randomly, due to thermal energy, much the same as holes do in the piece of p-type.

When a piece of p-type germanium and a piece of n-type germanium are side by side in the same crystal structure, some of the "meandering" holes in the p-type and some of the electrons in the n-type stray across the junction between the two. They tend to recombine in the vicinity of the junction (since they are of opposite charge), and the region around the junction becomes empty of free holes or electrons.

The junction thus widens into what is called a "depletion layer."

Now individual atoms of acceptor impurity in p-type germanium are negatively charged if they have four electron in their outer shell, instead of their regular three. Similarly, atoms of donor impurity in n-type germanium are pos tively charged if they only have fou electrons in their outer shell, instead o their regular five.

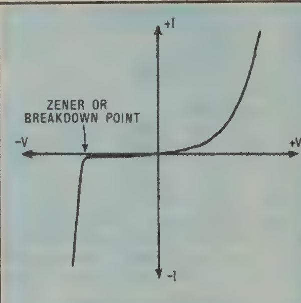

FIG. 1

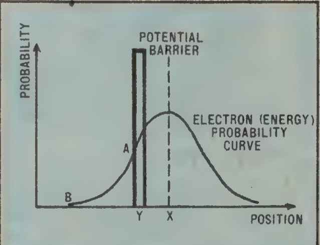

FIG. 2

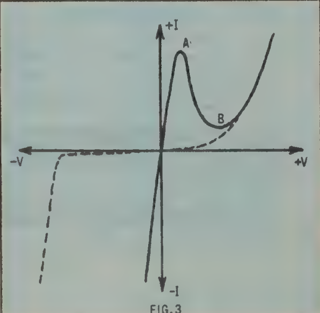

FIG. 3

Thus, the section of the depletio layer in the p-type germanium has a ne negative charge (as the holes have bee "filled up"), and the section of the depletion layer in the n-type germaniur has a net positive charge (as the fift electron of each impurity atom is missing). There is thus a potential differenc set up across the junction which discourages the passage of further hole and electrons. In short, a barrier t current flow is created.

BIASING EFFECTS

If we "forward bias" the junction b making the lump of p-type positive wit respect to the n-type, we gradually cancel out the effect of this inbuilt potential barrier, and current flows.

If we do the opposite, however, making the p-type negative with respect t the n-type (called reverse biasing) th external potential merely adds to th inbuilt barrier, making it even highe and the flow of current even less likely (Ultimately "breakdown" is reached— but that is another story.)

Thus a junction diode of this type ha the familiar voltage-current characteristic shown in figure 1. There is pract cally no current in the reverse directio of biasing, and a steadily increasing current in the forward direction of biasing

The proportion of impurity atoms pe volume of germanium crystal in th grades of p- and n-type germanium use in normal junction diodes and transisto is quite low. In fact, the ratio betwee germanium atoms and impurity atoms something like 1,000,000,000 — whic means there's very little impurity!

CURIOUS PHYSICIST

A Japanese physicist, Dr Leo Esak wondered what the effect of muc greater amounts of impurity would b and experimented with impurity concentrations of one part in a few hundre While so doing, he discovered the tunnelling effect, and brought considerabl fame on himself.

When we make a p-n junction usin this very high impurity concentratio the depletion layer formed is extremel narrow, something like one-millionth o a centimetre. When the depletion laye or barrier becomes this narrow, a peculiar effect labelled "quantum-mechanica tunnelling" occurs.

The modern science of quantu mechanics holds that we cannot acc ately define the position of things so mall as electrons—all we can do is say vhere they are in terms of probability. Thus each electron is imagined as a sort of "hump" in a probability curve. This s shown in Figure 2, where the "posi-ion" of the electron is X.

According to the theory, if a poten-ial barrier such as that shown at Y is hin, then there is a definite probability hat the electron won't be on the X side of it, but on the other side! This is hown by part of the probability curve, part A-B, being on the left side of the potential barrier.

The barrier may be any height, be-cause the electron does not go over the op; it merely appears on the other side. As the name suggests, it is regarded as having tunnelled through it. Doesn't use any energy, either! It also appears instantaneously, meaning that there is no "transit time" to worry us at high fre-quencies.

CHARACTERISTIC

If we have a look at the current-volt-age characteristic for a typical tunnel diode, we can see how this tunnelling process makes it differ from a normal junction diode. This is shown in Figure 3, with the normal diode curve included for comparison.

You will notice that the diode now has a very low resistance in the reverse direction. This is because the very thin depletion layer causes the diode to pass into the breakdown condition immedi-ately. It has a Zener voltage of effec-tively zero, in other words!

On the forward part of the curve, the initial peak is the main feature of in-terest. This is the result of the tunnelling process which we have describing. At very low forward voltages the tunnelling effect makes the diode act as a low resistance.

However, as the voltage is increased further the thin depletion layer barrier is cancelled by the forward bias. This causes the tunnelling current to decrease, and the curve reverts to that of a normal junction diode.

The section of the tunnel diode curve of most interest is that from point A to B. Over this section, diode current falls with increasing voltage; in other words, the diode acts as a negative resistance! It is this property which makes the tunnel diode such an interesting device.

Let us have a close look at the effect of negative resistance in a circuit. One application is with tuned circuits and oscillators, which we will consider first.

Consider the circuit shown in Figure 4, a parallel tuned circuit consisting of a capacitor C and an inductor L. If we apply a voltage pulse to the circuit, it will oscillate, due to the interchange in energy between the capacitor and the inductor. We would expect the voltage across the circuit to look like that shown in curve (a), where the frequency of oscillation is given by the resonant frequency of the tuned circuit.

However, the inductor in practice has winding resistance, and the capacitor also has leakage resistance. Thus there is a certain amount of resistance in the circuit. As you may know, resistance dissipates power when current flows through it. Thus the actual curve of circuit voltage is in (b), decreasing due to absorption of energy by the circuit resistance. You will recognise the classic damped wave train.

Figure 5 shows how we can represent the circuit resistance by an equivalent circuit resistance R shunting the total circuit. Now if this resistance has a value of infinity, it is apparent that the tuned circuit will not be damped, and the oscillations will continue indefinitely.

In practice, the resistance will be a certain value lower than infinity and so the oscillations die away. The lower the resistance, the faster the decay of oscillations.

NEGATIVE RESISTANCE

What happens if we put a negative resistance in parallel with the circuit? If you work out the resultant resistance of a resistor —R in parallel with an equal resistor of +R ohms, you will find that the answer is infinity.

(Continued on Page 85)

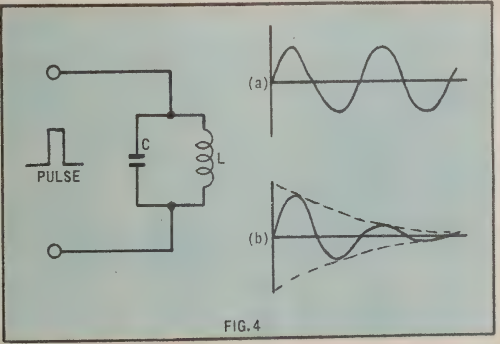

FIG. 4

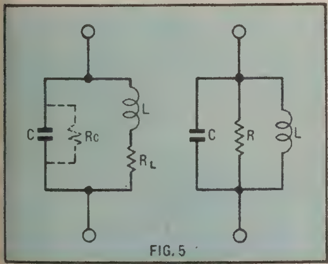

FIG. 5

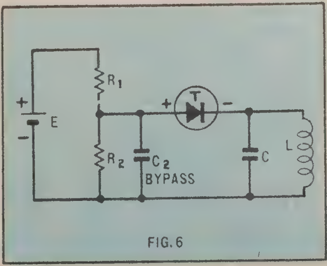

FIG. 6

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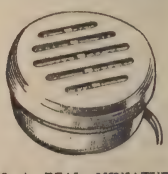

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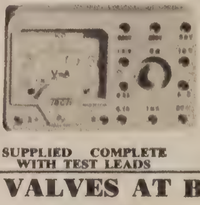

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3S4	10/	1Q5G	4/	1L5	9/6	6J7G	5/	12A6	5/
1R5	10/6	1P5G	2/6	6C8G	5/	7C7	3/6	EF50	2/6
1A7GT	9/6	1C7G	3/	6SS7	8/6	78	7/6	12SH7	5/
1D8GT	9/6			6H6	2/6	EL32	10/6	6K7G	4/6
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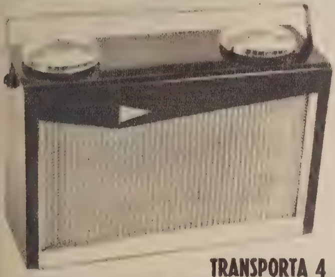

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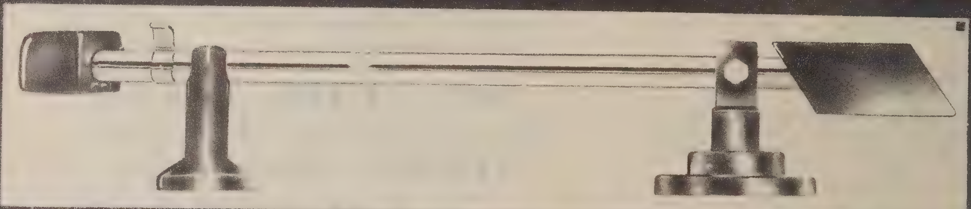

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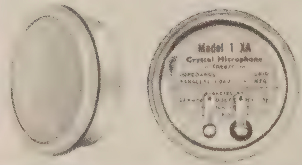

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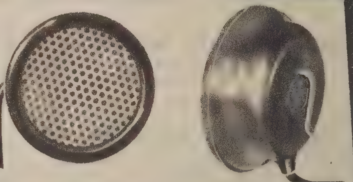

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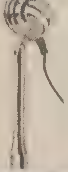
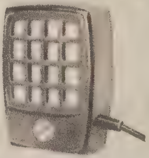


"8XA" CRYSTAL



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If the positive resistance is the lower value, the resultant turns out to be positive, and if the negative is the lower value, the resultant is negative.

Thus to make the circuit oscillate indefinitely, all we have to do is place a negative resistance in parallel with it, of a value the same as its positive equivalent resistance (or less, which causes the oscillations to get bigger. They don't grow to infinity, however, since all practical negative resistance is only so for a finite range of current and voltage).

Figure 6 shows the circuit for an oscillator which uses this principle. As before, we have the tuned circuit, comprising C and L. The tunnel diode T is effectively in parallel with this circuit, due to the action of the bypass capacitor C2. The battery E and resistors R1 and R2 are to bias the tunnel diode so that it operates on the negative resistance part of its curve.

TOTAL RESISTANCE

The value of the total circuit resistance (which includes R1 in parallel with R2, all in series with the tuned circuit resistance) is critical. This is because of the properties of practical negative resistance devices. Since these properties are most important to all tunnel diode theory, we had better consider them before we go any further.

In Figure 7 we see a typical tunnel diode curve. You will notice that the slope of the curve at any point is a conductance, not a resistance, as current is taken as the vertical quantity. The next thing you will notice is that for every value of voltage, there is only one value of current, but the reverse is not true. Thus the tunnel diode falls into the "voltage-controlled" class of negative resistances.

Similarly to valve conductance curves, we can draw loadlines to describe the operation of a tunnel diode when it is supplied from a battery of voltage E via a resistance R. Thus for any given voltage E and series resistance R, the operating point is given by the intersection of the loadline of slope equal to I over R, drawn through the point E and the tunnel diode curve.

Now look again at Fig. 7. If we connect a battery of voltage E1 to the tunnel diode through a resistance of value R1, there appear to be three possible operating points, as the loadline and diode curve intersect three times, at A, B and C.

In actual fact, there are only two operating points, because point B turns out to be unstable, the circuit flipping to either point A or C.

CRITICAL

For instance, if we gradually increase the voltage from zero, the circuit will climb up the first part of the curve until point X is reached, and then fly over to Z. If we then reduce the voltage again, the circuit will follow down to Y, but then fly back to U.

All this is fine for a flip-flop, as we shall see later, but it obviously is not much good if we want to operate the diode on the negative resistance part of its curve! The loadline must intersect the curve at one point only and that near the centre of its negative resistance region.

To do this, we must operate the circuit under conditions shown by the second loadline. This loadline is for a resistance lower than the value of negative resistance of the tunnel diode, namely R2, connected to a voltage E2. As you can see, it only cuts the diode curve in one spot, so this must be the operating point—and it's in the right place!

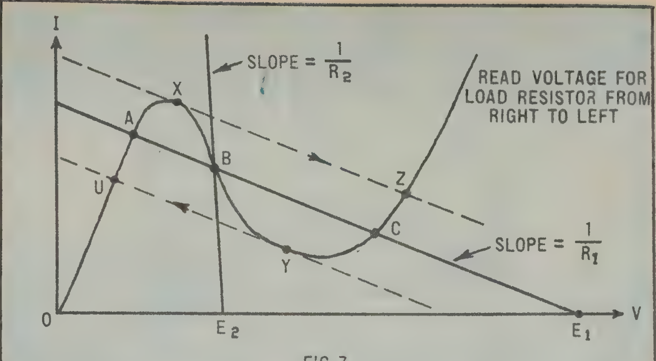
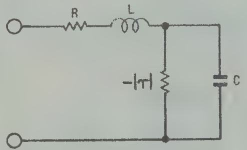


FIG. 7

So you can see that the total positive circuit resistance (which as far as the negative resistance is concerned is in series with the DC supply) must be lower than the negative resistance of the diode, or the thing just isn't a negative resistance.

But, just to be difficult, the circuit resistance must also be higher than a certain amount, or the diode oscillates itself! To explain this, we need to refer to the equivalent circuit for a tunnel diode.

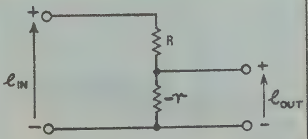
Figure 8 shows the equivalent circuit for a tunnel diode, when it is operated on the negative resistance part of its curve. (Thus it is the small-signal equivalent circuit only.) The negative resistance is represented by -r, the capacitance of the depletion layer of the junction by C, and the resistance and inductance of the germanium crystal and connecting leads by R and L.



$$f_{co} = \frac{1}{2\pi|r|C}\sqrt{\frac{-|r|}{R}-1}$$

$$f_o = \frac{1}{2\pi|r|C}\sqrt{|r|^2\frac{C}{L}-1}$$

FIG. 8



$$\text{GAIN } A = \frac{e_{OUT}}{e_{IN}} = \frac{-r}{R-r}$$

IF $R = 0$, $A = 1$

IF $R = r$, $A = \infty$

∴ FOR FINITE GAIN $0 < R < r$

FIG. 9

From considerations of this equivalent circuit, we find that at a certain frequency Fco, called the cutoff frequency, reactive effects in C and L combine with the positive resistance R to make the effective terminal resistance not negative, but positive. Naturally, above this frequency the diode no longer acts as a negative resistance, so it is no use. This determines the upper usable frequency of the tunnel diode.

SELF RESONANT

We also find that the diode is self-resonant at a frequency Fo, called the self-resonance frequency. Both these frequencies may be found by the equations shown in Figure 8.

If the self-resonant frequency for the diode happens to be below its cutoff frequency, it will oscillate when fed from a zero-resistance supply. If, however, the self-resonant frequency is above the cutoff frequency, the diode can readily be fed from a zero resistance supply, and will not oscillate unless used in an actual oscillator circuit. It is then spoken of as "short-circuit stable."

To operate the tunnel diode as an amplifier or oscillator, we must have it stable on its operating point. If we don't want it to oscillate at its self-resonant frequency, we must also arrange that it is short-circuit stable.

Looking at the equations for Fco and Fo, we see that this will happen if the value of the positive resistance R is equal to or greater than the ratio of L to (r times C).

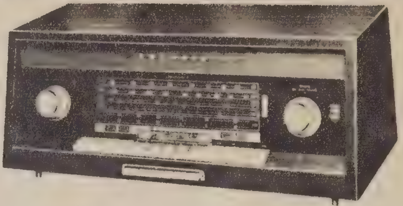
VALUE OF R

If the particular diode concerned has a value of R which satisfies this criterion, then we have no need to worry. But if it is lower, then we have to arrange the external circuit resistance (which is effectively in series with R, and therefore adds to it) so that it never falls below a certain figure. This places a lower limit on the circuit resistance.

Obviously, the tunnel diode is very critical of circuit resistance. To operate as an oscillator (or as an amplifier), the circuit positive resistance must be lower than r (for DC stability) and higher than L/rC to prevent it oscillating about its bias point at a frequency Fo.

(Note: "Circuit resistance" here includes the diode positive resistance R.)

GRUNDIG STEREOMASTER



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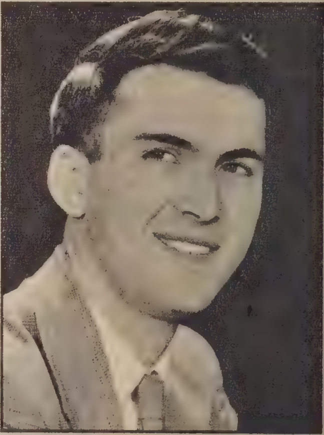
How do we use a tunnel diode as an amplifier? To explain this, we need only consider the tunnel diode as a negative resistance. The usual criteria still apply regarding circuit resistance, naturally, but it turns out that the conditions for amplification don't really clash with those for stability, so initially at least we can consider the diode as a negative resistance —r.

Figure 9 shows the basic tunnel diode amplifier. It is fairly obvious that it is derived from a voltage divider.

As shown, the circuit gives a positive finite gain if R lies between zero and r; the nearer it is to r, the higher the gain. (The only way in which these conditions could clash with the stability criteria is if the diode is not short-circuit stable, meaning that the value of R could not fall to zero. As the low limit of R is the region of low gain, we don't want to operate there anyway.)

In Figure 10 (a) we see the circuit for an untuned amplifier of this type. The input signal is placed in series with the DC diode bias, which is an AC short circuit because of the bypass capacitor. However, the bias supply must inevitably have a DC resistance, but this must be as low as possible, as the diode sees the circuit resistance as (R plus the source resistance).



Meet Jamieson (better known as "Jim") Rowe, a member of our technical staff and author of this and other articles in this issue.

This shows why there is a limit on the gain obtainable from the circuit. Since we cannot reduce the source resistance to zero, we cannot get infinite gain (or even very high gain, in practice), because to be DC stable the sum of R and the source resistance must be lower than r.

Incidentally, we can place a load resistance across the output terminals of this circuit, and still get a positive gain, as long as the load resistance is greater in absolute value than the diode negative resistance. The gain will change, of course. This is because a positive resistance in parallel with a negative resistance still gives a negative resistance, provided the negative resistance is the smaller value.

It is this fact which allows us to use the tunnel diode in a tuned amplifier.

igure 10 (b) shows a circuit for such an mplifier. It is basically the same circuit s before except that we have a tuned ircuit in parallel with the diode. The lotted resistor Rt represents the dynamic esistance of the tuned circuit at resonnce (including a reflected load, if any).

At frequencies other than the resonant requency of the tuned circuit, the diode inds itself shunted by a low positive mpedance, and the circuit has negligible ain. At the resonant frequency, howver, it is only shunted by Rt. Thus, rovided Rt is larger than r, the ciruit can be arranged to have a gain, by nanipulating R as before.

Perhaps the application in which the unnel diode is finding the most practical se is digital computing. This is because he tunnel diode can be used as a monotable or bi-stable flip-flop, in addition o performing other logical functions.

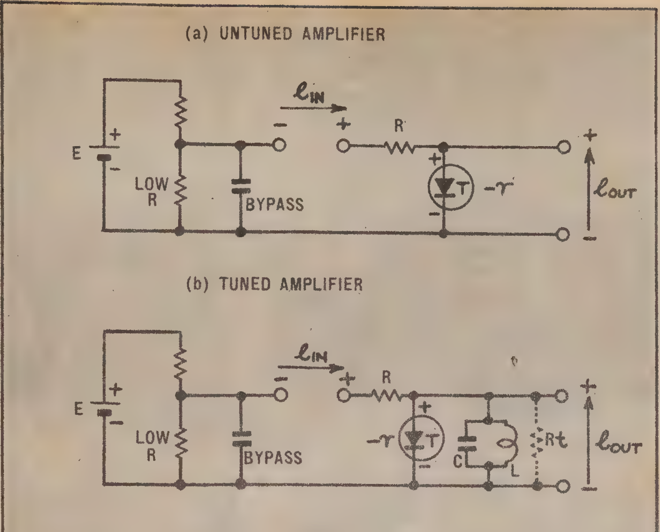


FIG. 10

FLIP-FLOP

We can understand how the tunnel liode can be operated as a flip-flop from he phenomenon we noticed about Figure '. Namely, with a load resistor whose 'alue is larger than r, it is not possible o have an operating point on the negaive resistance region of the curve.

Figure 11 (a) shows the tunnel diode sed as a mono-stable flip-flop. In the bsence of any input, the operating oint of the circuit is A.

If, however, an input current pulse qual to or greater than Ip minus Ia is pplied, the diode switches over to an perating point somewhere between B nd C. The added voltage implied by he switching operation comes from the tored energy in the inductance L. The ollapse in the magnetic field of the nductance produces an output voltage ulse in the secondary winding. When he input pulse drops to zero, the diode ircuit returns to its operating point at A.

If we have other inputs, each with a eries resistor Ro, this circuit becomes useful in digital computing circuits as an "AND" gate or an "OR" gate. For instance, if each of the input current ulses is equal to (Ip-Ia)/n, that means hat for the gate to flip over, n input pulses must occur simultaneously. The ircuit then has n input circuits, and is called an AND gate of n inputs.

If we have n input circuits, but each urrent pulse alone is equal to (or greater than) Ip-Ia, obviously any of the nputs could cause the diode to flip over. The circuit is then called an OR gate of n inputs.

BISTABLE CIRCUIT

The tunnel diode can also be arranged as a bi-stable flip-flop, as we said earlier. This is shown in Figure 11 (b). The circuit is similar to that of the monostable version, but here the load Rb is increased until, with a suitable supply voltage Ebb, there are two stable operating points, A and B.

If the circuit is initially at A, an input current pulse equal to (or greater than) Ip-Ia through an input resistor Ro will cause the diode to switch over to point B', as it has to be on the diode curve and a loadline corresponding to Ro. When the input pulse falls to zero, however, the diode falls down the curve to B, where it finds a stable operating point.

It will remain at point B unless a negative input current pulse equal to Ib-Iv is applied through any input resistor Ro. If this happens, it will switch back to point A' on the first positive part of the curve. When the negative input pulse falls to zero, the diode rises along its curve to point A, where it remains.

So you can see that this circuit has two equally stable operating points, and can be triggered from one to the other by input pulses of suitable size and polarity. Output is taken as the diode voltage in this case, but current relays and other output coupling methods are also used.

As before, this circuit may be arranged to be an AND gate or an OR gate, merely by arranging the magnitude of the required input pulse, and the size of the individual input pulses with respect to it.

That brings us to the end of our discussion of the basic principles concerned with the tunnel diode. In due course, we hope to present some practical circuits featuring the tunnel diode.

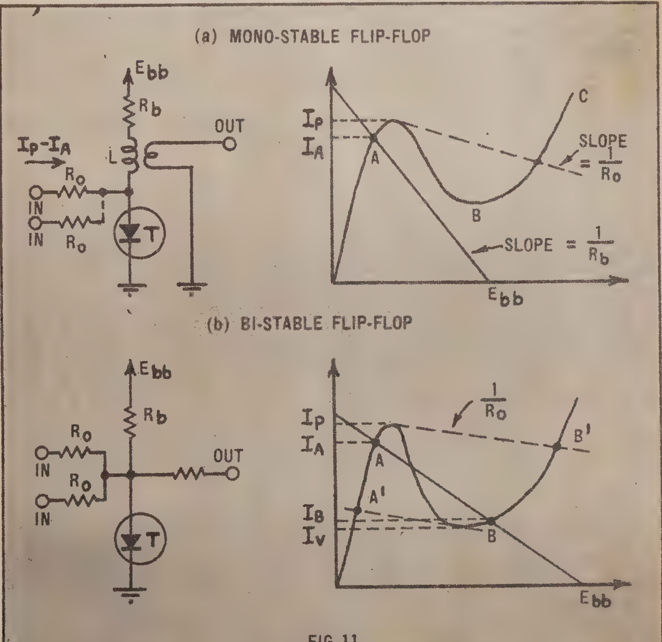
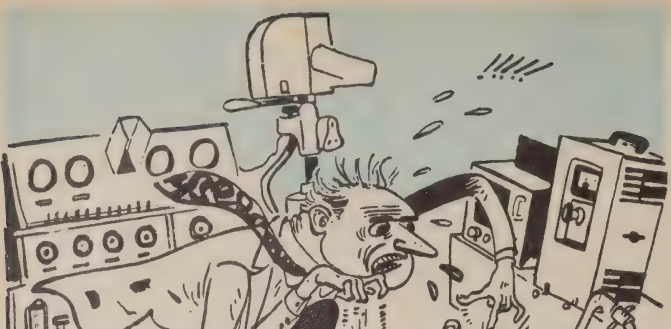


FIG. 11



Let's Buy An Argument

It's strange how the most unexpected items spark off the biggest ruckusses — or is the plural of ruckus, rucki? Whatever it is, we're faced with more letters on the subject of "Miller Effect," the apparent input capacitance which an audio valve acquires due to magnification of its own grid-plate capacitance.

By Neville Williams

THE first letter is reproduced in the panel opposite and frankly, upon reading it, I was prompted to a certain amount of head-scratching.

See if it affects you the same way!

From the first couple of paragraphs, it is clear that V.S. does not go along with my earlier statement that Miller Effect involves ALL capacitance between the plate and grid of an amplifier valve, irrespective of whether the capacitance is internal (inter-electrode capacitance) or external (due to the socket and the wiring thereto).

That much is plain but I'm afraid that I can't say the same for the reasoning which has led our correspondent to his conclusions.

SERIES & PARALLEL CIRCUITS

To be sure, one can have fun-and-games arguing about parallel and series circuits and it is a bit hard to tell, sometimes, which is which. As often as not, it boils down simply to which way you—or rather the signal—looks at the circuit.

Sometimes, the same circuit is both at the one time. I could refer, for example, to the kind of tone compensating arrangement which we dreamed up for our recent tape recorders.

At low frequencies, the inductor in the peaking circuit has little effect, the capacitors (in parallel) forming a series element in a reactive voltage divider, to give bass boost.

At middle frequencies, none of the components has much effect.

At the treble end, the capacitors in series become part of a parallel tuned circuit, which shows a sharp rise in impedance to produce an output peak at the frequency to which it is tuned.

See what I mean? You don't! I'm not surprised. But if you want an exercise in tone compensation, work out the operation, as outlined, of the little circui on page 49 of our last issue.

But, as far as Miller Effect is concerned, we are interested primarily in any capacitive path by which the signa at the plate of an amplifier valve can reach the grid. And the signal is not the least bit fussy whether the path happens to be inside or outside the glass envelope.

DEFINITELY IN PARALLEL

No, I'm afraid that, in the present context and at audio frequencies, where lead inductance is of no significance, the capacitances are simply and only in PARALLEL.

The next couple of paragraphs really have me twisted.

Our correspondent begins by assuming that a given signal impulse drives the grid negative. Assumption accepted!

Step 2: The anode will swing positive. Reasoning okay, thus far.

Step 3: The effect of Cgp will be to increase the negative swing on the grid, resulting in positive feedback. Wait a minute! How could this happen? A positive-going pulse at the plate, if coupled through a simple reactance to the grid, must induce on the grid a similar positive-going pulse. Even if shifted somewhat in phase, it would certainly not be rotated enough to constitute a phase reversal.

I did think, for a moment, that V.S. had merely typed the wrong word but such is obviously not the case from what follows. He goes on to point out that this negative swing constitutes POSITIVE feedback "leading to oscillation in the case of RF circuits." I'm afraid this is merely introducing one error to prove another.

Step 4: The signal fed from the plate to the grid through the external capacitor constitutes negative feedback, thus cancelling the positive feedback due to the internal capacitance. The first part of the statement is correct, the second part wrong, because there isn't any positive feedback to cancel.

In any case, our correspondent's reasoning about the two capacitances is blatantly inconsistent. If a positive pulse at the plate attracts electrons to the opposite side of the external capacitor (more argument?) then, equally, it will attract electrons to the grid, which forms the "opposite side" of the internal capacitor.

Our correspondent concludes. "Finally, what about these circuits?" I take it that these are supposed to constitute the coup de grace, or whatever it is.

Figure 3a is a conventional output pentode with a small value of capacitor from plate to grid to give treble attenuation. There's nothing unusual about this and it's entirely in keeping with what has been said earlier.

Figure 3b is a crystal oscillator and this gives the clue to our correspondent's dilemma, along with his earlier reference to instability in RF amplifiers. Why is it that grid-ate capacitance, which has been stated to give a negative edback voltage, can promote or sustain oscillation in RF rcuitry?

The answer, like many other things, is easy when you now how! Crystal oscillators, tuned-plate tuned-grid oscil-tors and RF amplifiers all have something in common—sonant input and output circuits. And in all resonant rcuits, the current and voltage present exhibit quite abrupt nanges in phase at frequencies close to resonance, the phase winging from something like 90 degrees one way to 90 egrees the other.

When the phase rotation due to the resonant plate cur-nt augments that across the grid-plate capacitance, the total tation is sufficient to constitute positive feedback, leading instability in the case of RF amplifiers or sustained oscil-tion in the case of RF oscillators.

In practice, the condition necessary for positive feed-ack via the grid-plate capacitor obtains when the resonant ate circuit is tuned to a frequency slightly higher than that the resonant grid circuit.

Figure 3c introduces the case where the phase condi-ons are presumably favourable for positive feedback, but scillation cannot be sustained because the grid-plate capaci-nce is too low to convey sufficient energy to make up e natural losses in the grid circuit. The external com-onent Cp provides the necessary additional capacitance.

PPARENT CONTRADICTION

So we have the apparent contradiction of a capacitor oviding negative feedback in one case and positive in e other.

The explanation: in one case the input and output cir-its are non-resonant and the only phase change is across e capacitor itself, being always less than 90 degrees. In e second case, the input and output circuits are resonant nd, when adjusted as noted above, the additional phase shift n swing the feedback voltage through to positive.

The second letter is one which will take a good deal ore digesting and the sight of it certainly caused our com-ositors to swallow hard. In a large newspaper office, the achinery is geared to handle huge quantities of copy cover-g everything from classified adverts to love stories but not -I repeat—NOT mathematics.

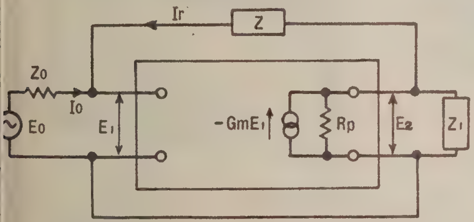
Anyhow, the compositors smiled bravely, did their very ccellent best with the facilities available but extracted a omise of "never again." So I quote:

Dear Mr Williams,

I thought you may be interested in the attached nalysis of the Miller Effect, in view of the article on me in the November 'R, TV & H.'

Yours faithfully, G.P."

Then follows "the attached analysis":



Let Eo=open-circuit source voltage and Zo=source im-dance; also let Yp=1/Rp, Y1=1/Z1, and Y=1/Z.

Any of these quantities may be complex.

Then $Ir = (E_2 - E_1)Y$.

Summing currents in the output circuit,

$$-Gm\,E_1 = Yp\,E_2 + Y1\,E_2 + Ir.$$
$$= E_2(Yp + Y + Y1) - YE_1.$$

Therefore $E_1(Y - Gm) = E_2(Yp + Y + Y1)$.

The amplifier gain is then

$$\frac{E_2}{E_1} = \frac{Y - Gm}{Yp + Y + Y1} \quad \ldots\ldots\ldots \; (1)$$

However, the input impedance is affected by feedback, nd we really want to know the voltage transfer ratio E_2/E_1.

Now $E_1 = Eo - Io\,Zo$ as the valve input current is ro, making $Io = -Ir$.

$$= Eo + Ir\,Zo$$
$$= Eo + ZoY(E_2 - E_1)$$

Therefore
$$E_1 = \frac{Eo + ZoYE_2}{1 + Zo\,Y} \quad \ldots\ldots\ldots \; (2)$$

SOMETHING DOESN'T CHECK

In your November issue you make a statement that I cannot let go unchallenged, to the effect that it does not make any difference whether the plate grid capacitance is inside the valve or outside it. I presume you say this because these capacitances are in parallel . . . but are they?

It all depends on how you look at them. In figure 1a they are clearly in parallel, but in 1b they are also clearly in series. In the valve it seems to me that the voltage is generated in series with the Cgp, and any external anode grid capacitor, and the effect of these capacitances is not the same.

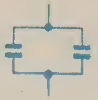


FIG 1a.

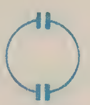


FIG. 1b.

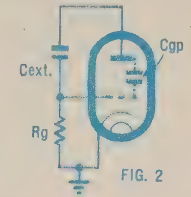


FIG. 2

Referring now to the circuit of figure 2, let us imagine the grid being driven negative by a signal. The anode will, of course, swing positive and the effect of the Cgp will be to increase the negative swing of the grid by an amount depending on the valve gain.

Thus Miller capacitance gives positive feedback leading to oscillation in the case of RF circuits which is, of course, why triodes are not used in these circuits without special precautions. Now when the anode goes positive so also will the plate of Cext. connected to it.

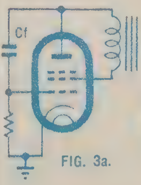


FIG. 3a.

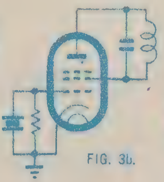


FIG. 3b.

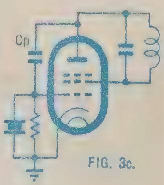


FIG. 3c.

This will attract electrons to the lower plate to balance the charge. Since Rg will be a high value and will consequently only pass a small current there is only one place these electrons can come from and that's the grid which will now become LESS negative than it is due to the applied signal. Thus Cext. cancels the effect of the internal capacitance and produces negative feedback.

Finally, what about the circuits in figure 3?

Fig 3a is a conventional output pentode in which Cf is added to produce treble attenuation by negative feedback. A typical value would be about 100 pf. 3b is a conventional pentode crystal oscillator. In some cases it is necessary to add a small external capacitor Cp as on 3c to ensure stable oscillation, because of the low Cgp of a pentode . . . but we've just shown that this is NEGATIVE feedback . . . or have we! That should buy an argument.

Yours faithfully, V.S.

Substituting (2) into (1) and reducing gives

$$\frac{E_2}{Eo} = \frac{1 - GmZ}{1 + Zo\,(Yp + Y1 + Gm) + (Yp + Y1)Z}$$

If both the amplification factor of the valve and the gain without feedback are much greater than unity, in other words if Gm is much greater than Yp and Gm is much greater than Y_1, then the transfer ratio

$$\frac{E_2}{Eo} \text{ approximately equals } \frac{1 - Gm\,Z}{1 + Zo\,Gm + Z\,(Yp + Y1)}$$

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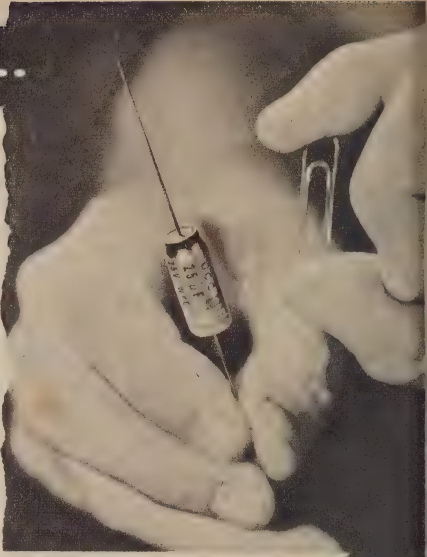

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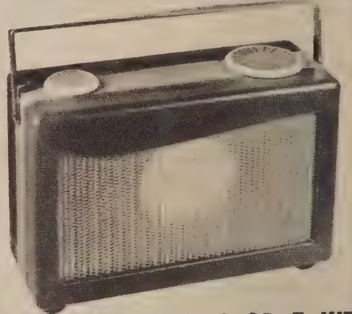

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If a capacitor is used for feedback, then at high enough equencies Z approaches O, and the amplifier gain is symptotic to

$$\frac{E_2}{E_1} = 1 \text{ (note that the phase reversal has disappeared)}$$

nd the transfer ratio to

$$\frac{E_2}{Eo} = \frac{1}{1 + ZoGm} \text{ which may be very small.}$$

If Z comprises a capacitor in series with a resistor R, nd if Gm is much greater than 1/R, then the RF gain is symptotic to

$$\frac{E_2}{E_1} = -Gm\ Req., \text{ where } Req = Rp//R1//R$$

The voltage transfer ratio at HF is asymptotic to

$$\frac{E_2}{Eo} = \frac{-\ Gm\ \ R}{1 + GmZo + R\ \ (Yp + Y1)}$$

hich, if Zo Gm is much greater than 1, and also much less an R(Yp + Y1) as is usually the case, gives

$$\frac{E_2}{Eo} = \frac{-\ R}{Zo}$$

hich is the standard result for an "operational amplifier" f the type used in analogue computers (or for an "anode ollower" when R equals Zo).

UMMING UP

Well, thank you, G.P. for your contribution, which some eaders will have waded through, and others will have skiped.

An interesting point, in the light of remarks in the Noember issue, is that the gain is asymptotic to unity, the phase hange having disappeared.

This is obvious enough from the circuit, once it is pointd out. If the plate-grid capacitance has a very low reactance, ither due to its large capacitance or to a very high signal requency, then it bridges the input and output circuits irectly, irrespective of what the valve happens to be trying o do.

Admittedly, this would represent an extreme condition, nvolving large capacitors added for frequency correction or, lternatively, signal frequencies so high that they would probbly have suffered attenuation from other shunt paths. Then, f course, there's the matter of loading of the output circuit n what was intended as the valve input. Nevertheless, it is ll very interesting.

However, I feel that the point I made in the November ssue remains completely valid. Whether the gain curve is symptotic to zero or to unity, irrespective of phase, it represents such a degree of attenuation in a practical audio stage, hat the difference is of academic interest only.

To change the subject, but only slightly — I would direct your attention to the letter on this page "It's All So Very Easy."

When we published the first article on the proposed hange to decimal currency, it prompted a series of letters rom readers, not all of which have appeared in these columns. Those which have appeared, including the one herewith, are sufficient to indicate that it is a subject of considerble interest and with many facets.

The letters have emphasised, among other things, that it sn't enough merely to assume that **it must be better because t's decimal.** The point has to be proved.

MONEY ONLY?

Whenever the subject is raised in the presence of our Technical Editor, preferably with cup of coffee in hand, he tends to wax eloquent along a line which has not thus far been pushed by our correspondents.

His contention (over a cup of coffee, that is) is that a change to decimal currency alone will not represent any great economy. In order to realise its potential benefits, it has to be combined with decimal units of weight and length.

Had he his way, our storekeepers and housewives would have a busy time, as from the appropriate date, learning not only a new coinage system, but also about grams and metres.

What a hope, when just about every female I have ever met (I mean female females, bless their hearts) insist on buying an extra sixth of a yard of cloth, when all they need is an extra six inches.

But seriously, I am inclined to have respect for any decision reached by the committees set up by the Government to examine the whole question. I doubt that businessmen and bankers will be convinced that a change is desirable, without having been confronted by pretty potent evidence in favour thereof.

ALL SO VERY EASY!

Dear Sir,

As a regular reader of R. TV and H. for the last 15 years, I feel I must voice my disagreement with the opinions of L.C.D. (Sturt, S.A.).

The British pound may be one of the most remarkable pieces of currency in the world today and it certainly is divisible in many different ways but this cannot be taken as an argument for its retention.

In Hobart the most frequently observed price is 19/11 (equals 239 pence) and this is divisible only by 1 and by 239.

Actually the only fair comparison between two sets of units is that based on the labour involved in normal everyday computations involving the units. Here a "pure" system wins hands down from a "mixed" system. Thus we find most people prefer the decimal system, since it is based on our accustomed method of counting.

The question now arises "which is the best number on which to base a system of counting?"

As L.C.D. points out, the base 12 has some definite advantages. For instance the number 128,670 in decimals would be written 62566 (not ZZE94) in duodecimals. Thus the duodecimal system requires fewer digits for some numbers.

On the other hand, to calculate in duodecimals one has to remember 78 addition combinations and 66 multiplication combinations as against 55 and 45 combinations respectively in the present system Also if a number is divisible by say 4 when expressed in one system it is also divisible by 4 in any other system.

Undoubtedly the easiest system to use is the dyadic (base 2) system. Even L.C.D. should be able to do arithmetic in this system as it requires that only 3 addition and 1 multiplication combinations be remembered. The objection to this system becomes only too apparent when we deal with large numbers

441 (decimal) = 110,111,001 (dyadic).

However numbers in the dyadic system may be very easily translated into numbers in any system with a base of the form 2. The base 8 (= 2 cubed) turns out to be a handy compromise and also affords a very simple systematic form of notation base on the letter E. The lowest horizontal bar represents 1, the middle bar 2 and the upper bar 4. The vertical bar on its own denotes 0.

Thus I (octonal) = 0 (decimal)
L = 1
F = 6
E = 7
L L = 9
F E L = 441

If you cannot do arithmetic in this system with its 36 addition combinations and 28 multiplication combinations you simply translate the numbers into dyadic numbers by writing a 1 for each horizontal bar and a 0 for each blank space (taken in order), work out your sum, and then translate back to the octonal system by the reverse process.

I could write reams on this topic but I guess I must put the full stop here.

Yours Faithfully, W. D. B.

As to our correspondents, I can't feeling, equally, that the whole question has afforded some of them a glorious opportunity to indulge their passion for mathematical exercises, as distinct from an urgent interest in economics.

They talk about other systems of counting and calculation, not as curiosities from a textbook but as something that everybody should appreciate as a matter of course. Let's all suddenly start doing things in twelves or twos, or with letters instead of figures. It's all so very easy.

Well, not me. I learned the hard way to count up to ten then on to twenty, with my boots off. Best we leave it that way. In fact, it may be a good idea to draw the curtain over the subject for a while.

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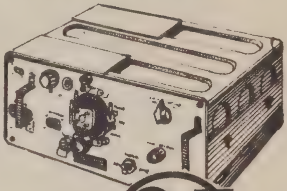

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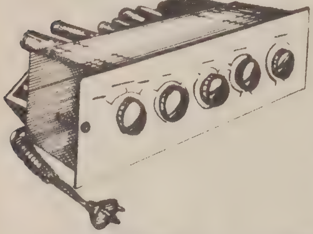

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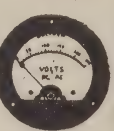

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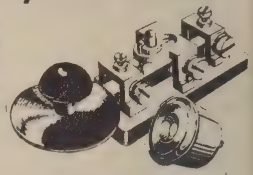

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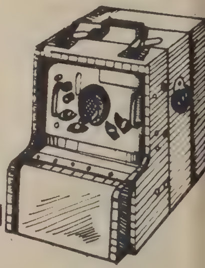

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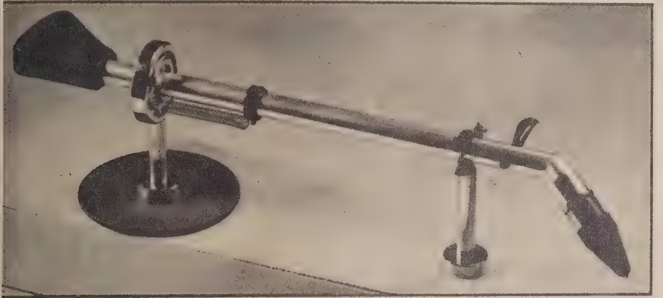
TRADE REVIEWS AND RELEASES

COMPLETE "B & O" PICKUP NOW AVAILABLE

The B & O (Bang & Olufsen) stereo magnetic pickup pictured below is one of the types which has received a good deal of attention and favourable mention in the overseas technical press. It was recently submitted to us for assessment by Messrs. Radio Parts Pty. Ltd. of 562 Spencer Street, Melbourne.



THE reasons for the pickup's favourable impact are not hard to disover.

The finish is excellent and the asmbly has a feel of rigidity and comactness, which is nevertheless combind with extreme freedom of movement n all directions. This is confirmed by he ease with which the pickup tracks t quite low stylus pressure.

A further point of interest is that he prominent position of the stylus makes it very easy to locate on a paricular band.

Checks with a stereo test record indicate that the frequency response is smooth over the whole range (in this case 40 cps to 12Kc.), with good wave form both on the separate stereo tracks and with the coils paralleled for mono.

The balance between the respective sides is also excellent and the stereo separation at all frequencies as good as anything we have yet seen.

Another commendable feature, noted in a previous review of the head alone, is the complete lack of sensitivity to external magnetic fields, so that the only sound heard at full gain is amplifier hiss.

The one point of criticism is that we would have preferred to see a lower figure for dynamic mass than "less than 3 mg." but then, can the one design have everything? As it is, the B and O has plenty. (WNW).

AKG MICROPHONE STAND

A FURTHER item in the AKG range of audio equipment available on the local market is a studio microphone stand, type ST200.

This stand features a special anti-shock base to prevent floor vibration being picked up by sensitive microphones, as well as excellent stability due to the widely spaced feet and low centre of gravity. To facilitate easy transport and storage, the feet fold together when not in use thereby saving considerable space.

Showing the ST200 stand as erected for use and also as folded for easy storage and transport. Note the folding legs.

The stand has a satin finish to prevent light reflections which would be undesirable when used for motion picture or TV work and is equipped with telescopic extension and omnidirectional microphone clamp. The microphone cable may be run within the telescopic extension or on the outside, in which case a hook at the base of the stand protects against a sudden drag on the cable.

All inquiries regarding price, availability, etc., should be addressed to Amalgamated Wireless (Aust.) Limited, 47 York Street, Sydney, who are the Australian agents.

NEW TAPE DICTATION MACHINE

RECENTLY introduced to the Australian market is a new dictation machine produced by Philips Electrical Industries and marketed in Australia by Stott and Underwood Ltd.

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The machine has only five simple controls, which have automatic locking devices to prevent accidental erasure or damage to the tape. Three of these controls are arranged in a convenient fingertip control panel, which can be placed n front of the typewriter for ease and peed of operation when transcribing.

Complete with microphone/speaker, headset, both foot and fingertip controls, tape loader and indexed log pads, it sells at £110. Extra loaded cassettes cost £2/5/ each. For further information contact Stott and Underwood Ltd.

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R.F. Control Variable with 2 taps.
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Tube Complement: 12BH7. 6AR5.
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12W. approx.

Size and weight: 6½in x 10in x 4½in. 6lb.

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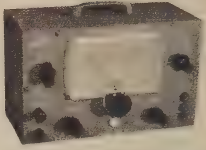

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1. The sweep covers a range from 3 M.C. to 270 M.C. in two continuous bands, covers all sound, video and F.M. Frequencies, both carrier and I.F.
2. The Marker covers range from 3 M.C. to 225 M.C. using both fundamentals and harmonics.
3. The sweep deviation is very wide, better than 12 M.C. which permits the aligning of practically all the TV and F.M. sets on the market.
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Price £78/16/8 plus 12½% Tax £9/17/1 — £88/13/9 plus freight.

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Record Changer as above—but mixer type, very well-known make, very reliable, will give excellent tone and performance.

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RECORD PLAYER AMPLIFIER. Latest type English four-speed record player with turnover head, pickup and two sapphire styli in handsome case finished in two-tone green, red or fawn. Amplifier has variable tone control. Ideal for parties, dances, etc., also for music lover. **These are a really good buy for £19/19/-.**

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SPRING GRAMOPHONE MOTORS. Wind-up type suitable for replacement in Portable Gramophones and also for hobbyist, complete with turntable and all fittings. **10/- ea.**

SOUND BOXES for above spring gramo. **7/6.**
TONE ARMS FOR ABOVE, 6/- ea.
4-SPEED GRAMO. MOTORS, to operate from 240-volt supply. Each has speed control knob for 16, 33, 45 and 75 r.p.m. and also on-off switch. A good, reasonably priced motor. English make, brand new and boxed.

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IMPORTED PICKUP ARMS with turnover crystal cartridge and 2 sapphire styli, ideal to use with above 4-speed motor or similar job. **Price only 35/-.**

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29	31	**9/4**
30	33	**10/7**
31	34	**11/11**
32	35	**13/4**
33	36	**13/5**
36	40	**19/7**
37	41	**21/1**
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1½-inch	**6d**
2-inch	**8d**
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WIDE RANGE ACOS CARTRIDGE

Illustrated herewith is the new "Acos GP67-1" monophonic turnover cartridge, marketed in Australia by Amplion Pty. Ltd., of 101 Pyrmont Bridge Road, Camperdown, N.S.W. This new crystal cartridge supersedes all previous mono types such as HGP37 etc., and is a direct replacement with improved specifications.

MANUFACTURERS' literature indicates the frequency response as been extended to cover the range of -14,000 cps, with improved tracking apabilities. The tracking weight is uoted as 5 to 7 grams which is quite asonable for a cartridge of this nature.

Output is given as 160mV at 1 cm/sec MS with an average of approximately 50mV into the recommended input imedance of 2 megohms.

Manfacturers' specifications indicate at the response should be substantially at when fed into the recommended imedance, and no further correction is equired. However, if a constant velo-ty output is desired, the pickup should e fed through a 520 pF capacitor into a 7K load resistor and R.I.A.A. compenation applied.

A high output version, known as the GP67-2," is intended only for single alve low gain amplifiers. This cartdge is listed as having a reduced freuency response 30-8,000cps, an average output of 1.5 volts and a tracking weight of 8 to 10 grams.

Both cartridges would appear to be substantial improvements over previous designs in this class and would be a logical choice where it is desired to provide good quality results at a moderate price. Further details may be obtained from Amplion Pty. Ltd.

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Home constructors of audio equipment will be interested in the new "multi purpose" amplifier chassis kit recently introduced by A & R Electronic Equipment Co. Pty. Ltd.

SIMILAR in outward appearance to the A and R 5 stereo 7 amplifier it this new unit caters for a variety of onaural and stereo circuit arrangenents, including pre-amplifier sections o cover the use of low level pickups.

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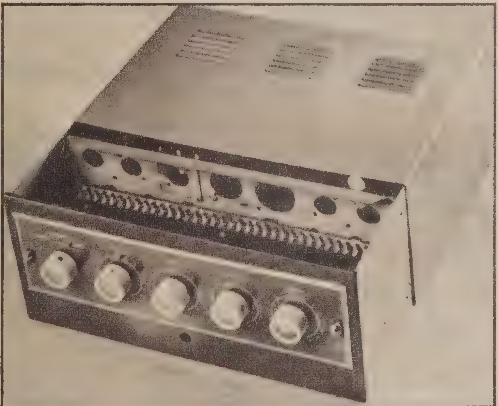
☆

his photograph hows the panel nd a portion of he chassis layut. It should e noted that the nobs and conols are not part f the basic kit nd were merely laced in position o give some idea s to appearance f the finished roduct.

☆



Some of the units which can be built using the kit as a foundation are the stereo amplifier and pre-amplifier control unit described in R. TV and H. for December, 1959, the stereo amplifier using push pull 6BM8's R., TV and H., August, 1960 and some of the more popular monaural amplifiers such as the Mullard 5/10 (with or without pre-amplifier).

All inquiries as to price, etc., should be directed to the manufacturers or their local agents.

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R. and H. 5in Moderne Standard C.R.O. case, chassis and printed panel, June 1960. £9/18/6.

R. and H. 3in Service C.R.O. case, chassis and printed panel. Sept. 1960. £7/10/-.

R. and H. Audio Square Generator. April-May. 1960. £3/18/6. Case, chassis, and printed panel.

R. and H. Sweep Generator. May, 1960. £3/4/6. Case, chassis, and printed panel.

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TECHNICAL BOOK REVIEW

THE ARRL Antenna Book, Ninth edition, 1960, published by the American Radio Relay League. Soft cover, 320 pages of editorial text, plus extensive bibliography and index, with a large number of photographs and diagrams. 6½ - 9½in.

This new edition of the ARRL antenna book follows closely the previous editions, but has been thoroughly revised and brought up to date, in order to present the latest trends and practices in amateur radio antenna design and construction.

Opening chapters cover the general principles of wave propagation and antenna fundamentals. In this section the authors have gone to some lengths to ensure that, while the beginner is never left behind, those more technically inclined are given adequate coverage of the theory involved.

Another chapter, on multi-element directive arrays, gives a comprehensive coverage of design data for this type of antenna. Profusely illustrated per media of polar diagrams, graphs etc, the theory of this subject is painlessly administered.

In the succeeding chapters, practical details are given on the construction of long wire, multiband, VHF, UHF and rotary beams. Illustration by diagrams is extensive and photographs of the finished products will help the reader in the duplication of proven designs.

The concluding chapter covers the theoretical and practical construction of antennas for mobile operation in the range from 1.8 to 30 Mc, and concludes with a section on field strength measurement.

In brief, an excellent and practical reference book, giving complete coverage to the subject of antennas for use by amateur stations.

Our copy came direct from the publishers, but supplies are available from local bookstalls at the Australian price of 31/-.

★ ★ ★

"PRACTICAL TV TROUBLE SHOOTING," compiled by the staff of Gernsback Library Inc. Soft cover, 128 pages, 8½ inches by 4½ inches. Published by the Gernsback Library Inc., New York.

This book is comprised of a selection of outstanding servicing articles from "Radio-Electronics" magazine. The servicing methods represent the actual bench experience of some of the top American service technicians in the business.

The book assumes that the reader already has a good grounding in the fundamentals of TV theory and is primarily interested in a little help to track down really tough troubles.

Chapter one covers the subject of intermittents, in which a step-by-step process of elimination is shown in order to avoid haphazard testing. Next comes a chapter on ghosts, in which this form of trouble caused by circuit action in the receiver, mismatching in the feedline, etc., is covered.

Further chapters cover such things as oscillator squegging, IF oscillation, horizontal oscillator and output stage troubles and the servicing of auxiliary circuits. The subject matter is presented in an easy-to-understand, straightforward fashion and illustrated by way of photographs showing the effects of the various faults on the TV picture.

No book on television servicing can ever be complete and this one makes no such pretence. However, your best servicing tool still continues to be your experience and if, to your own, you can add the experience of others (as described in this book), then you've given yourself a boost up technically.

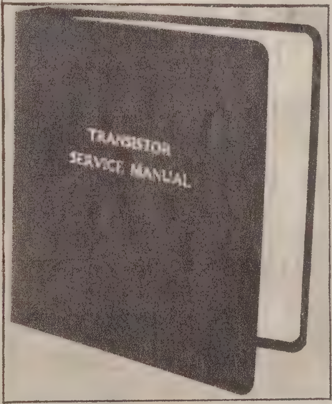
Our copy of the book was direct from the publishers and no Australian price was given, but the book will no doubt be available in due course.

★ ★ ★

TRANSISTOR SERVICE MANUAL. Published by Westley Contractors, of 67 Jocelyn Street, Chester Hill, N.S.W. Loose-leafed, hard-backed plastic cover, 270 pages 11¾in by 10in.

The servicing of transistor portable and "personal portable" radios has, in the past, been complicated by the lack of information available regarding circuitry and layout.

Containing, as it does, an almost complete coverage of the Australian and major imported brands of transistor radios, this new transistor service manual should go a long way towards solving this problem.



Commencing with a chapter which gives an introduction to transistor servicing, the manual then proceeds to circuit diagrams, alignment procedure and layout details covering approximately 98 per cent of Australian-produced sets and 55 Japanese sets, including such names as Toshiba, Sanya, Sony, Standard, Sharp, National and Matsushiba.

Equipped with an easy-to-find index, the manual has red tabs for Australian receivers and green tabs for Japanese.

Due to the rapidly expanding nature of this field it is essential that a manual such as this be kept up to date with new circuits and data as it becomes available.

The manufacturers have recognised this need and provide a service whereby, for an annual subscription of £2, additional circuits will be forwarded direct to the user as they are published.

In the event of non-subscription to this service, complete lists of all new circuits available will be forwarded to registered users of the manual. The individual cost of these circuits is 9d per copy.

Our copy came direct from the publishers, Westley Contractors, but copies are now available from all leading radio trade houses and technical booksellers.

★ ★ ★

"MINIWATT ELECTRONICS HANDBOOK." Published by the "Miniwatt" electronics division of Philips Electrical Industries Pty. Ltd. Hard cover, approximately 300 pages. 6 inches by 4½ inches.

The book commences with a chapter giving instructions on the application of electron valves in which such things as design centre maximum, interpretation of data, mounting and microphonic effects of audio frequency valves are covered. It is necessary to know, on occasions, the exact conditions under which data, for a particular valve, may be applied, and this chapter goes a long way toward clarifying this position.

Each of the valves covered is included in an E.I.A. (American) to European type number cross-reference and a valve classification guide is given in which the valves are listed for use in AM, FM and TV receivers, audio and car radios.

The remainder of the book is devoted to supplying complete data, averaging four pages per valve, on each valve and semiconductor.

In this section such things as base connections, maximum ratings, typical characteristics and operating conditions, including mutual conductance, plate resistance, etc., are covered, together with the Ia/Vg and Ia/Va graphs.

For RF and IF valves a curve has been included showing the hum voltage which must be present on the control grid to cause a modulation hum of 1 per cent, as a function of the mutual conductance.

Typical operating conditions as an R.C. coupled amplifier are given for each of the audio valves in which voltage gain and harmonic distortion figures are supplied for various values of plate, grid and cathode resistors in association with different supply voltages.

Most radio transmitters and receivers are designed and built around the thermionic valve and this book, covering the valves, picture tubes and semiconductors in popular usage today, has been written with the express purpose of providing appropriate technical data for engineer and amateur alike.

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OFF THE RECORD — NEWS & REVIEWS

PROBLEM — BIG BASS FROM SMALL ENCLOSURES

There's an old "audio" maxim that many of us have used at times, which suggests that, in the field of loudspeakers and enclosures, "there's no real substitute for cubic feet." In other words, the bigger the better. This maxim still holds fairly true—unless it is side-stepped by very deliberate and very definite design work.

THE use of large loudspeakers and large baffles (or enclosures) has long been accepted as a prerequisite to sustained bass response because:

(a) Only a large cone can allegedly move enough air to produced substantial low frequency output, without having to oscillate through too great a distance, and

(b) A large baffle or a capacious enclosure is necessary to prevent front and rear radiations from the cone cancelling one another at low frequencies.

Statement (a) is only partly corect, because the limits on cone size and movement depend on the required sound level. The needs of some may conceivably be met by a loudspeaker of more modest dimensions.

Statement (b) is nearer the truth unless, as I said at the beginning, very deliberate design measures are taken to side-step it. For a given order of low frequency response, large and small speakers alike need generous baffling.

FALLACY

This statement will cut right across a belief that some appear to hold, namely that small speakers only need small baffles. I'm afraid not.

To be sure, small speakers are frequently used with small baffles and boxes but the reason, more often than not, is that it would be illogical economically to do anything else. You put a compact, economy speaker in a compact, economy box and you get—"compact, economy bass response."

For these very general reasons, high fidelity fans have come to regard the standard minimum requirement as a 12-inch speaker (preferably with a generous magnet and voice coil system) and an enclosure of one type or another encompassing at least six cubic feet.

But, of course, such an enclosure in a small room can lead to domestic complications and there has always been some pressure to develop enclosures of smaller dimensions which would give equivalent results. With the advent of stereo and the need for two enclosures, the pressure has been multiplied in a somewhat greater ratio.

But, unfortunately, one cannot "scale down" enclosures, without running into serious problems.

THE VENTED ENCLOSURE

Let's consider, for example, the so-popular vented enclosure. Though they have been generously insulted, the fact remains that a well-built, well-padded, vented enclosure, with a content of six cubic feet or more, and carrying a 12-inch speaker, sounds pretty good to most ears.

You can achieve some reduction in cubic content by putting in a throat in place of the simple port opening. Instead, or simultaneously, the throat or port area can be reduced.

But try to carry the process too far and the throat becomes too long to fit in the box, or the contribution of the vent to total output starts to fall away. Pretty soon, you're having to compromise in a quite alarming fashion.

As a possible way out of the difficulty the so-called R-J type of enclosure received some attention. This had the speaker on a separate baffle set back a little from the front of the cabinet. Air could move around the edge of the baffle, in the space between baffle and cabinet front, simulating the effect of a port, venting through the same hole as the loudspeaker.

It was claimed that the scheme effected a basic economy in overall dimensions, ensuring big results from a smaller cabinet. In fact, the scheme enjoyed only limited popularity, allegedly because most constructors found the enclosure critical to adjust. And, if they didn't get it right, it lacked bass or sounded "lumpy."

What of folded horn type enclosures? Well, you can't shorten the horn duct without affecting results, because the wavelength of sound for a given set of frequencies, stays stubbornly constant. Reducing the cross-section of the horn has its limitations, too, because it ceases to behave like a horn, or even a duct, if the cross-section is made too much smaller than the cone in the speaker you want to use.

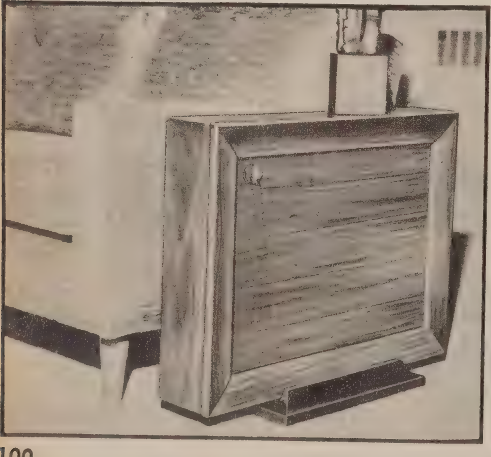
So-called "infinite baffles" or sealed boxes are fine, if they are rigidly built, heavily padded and have a content of at least nine cubic feet. Many audio enthusiasts prefer them to anything else, because they often exhibit fewer response irregularities than other types, where the air behind the cone is not completely sealed in.

EFFECT ON RESONANCE

In fact, the air trapped in a sealed box has a certain "springiness" which raises the natural resonance of the loudspeaker cone.

With nine or more cubic feet, the effect isn't very great.

But start reducing the size of the completely sealed box and the effect of the trapped air on the cone resonance becomes more and more marked. Very soon, the dull thunder of a 45-cycle resonance climbs to the "boomp" of a



Breaking completely with accepted loudspeaker design principles, the "440 Bi-Phonic coupler" has no cone as such but radiates sound from thin wooden panels which form the faces of the unit. Measuring 24 inches high, 18 inches wide and 4½ inches deep, the coupler incorporates a 20-pound magnet structure, 7½ inches in diameter, to drive a "short-travel" voice coil. Frequency response is claimed to be from 30cps to beyond audibility and power requirements a nominal 15 watts (presumably the rating of amplifier required). Suitable for standing on the floor as pictured, or to be hung from the wall, the unit lists at 134 dollars 40 cents. The manufacturers make lavish claims for the performance, though this is not unusual in sales literature. (Advanced Acoustics, Inc., 67 East Centre Street, Nutley 10, New Jersey).

60-cycle resonance, with a sharply tapering curve on the low side.

What to do? Mr Hartley and others found a partial answer to this by providing a path by which the back pressure could find some relief, but impeding its flow with a pattern of holes or suitable absorbent material. They minimised higher frequency reflections inside the smaller box and provided some absorption and isolation of the back wave, while seeking to minimise the rise in cone resonance.

This was the basis of the Hartley "Boffle."

If well executed, such an approach can yield a tapering but smooth bass response in a box of moderate dimensions and the balance can be enhanced electrically by the discreet use of bass boost.

But is that the end of the road? Many designers have been unwilling to accept it as such and have persevered in the attempt to get something approaching level response from really small enclosures—something which could even sit on a shelf.

USUAL APPROACH

The most popular line of approach has been via completely sealed boxes. But what of the resonance problem? It is plainly futile to countenance anything which produces a resonance in the 100-cycle region.

Fortunately, there is a way round this, and here is where the deliberate design comes into it, referred to in earlier paragraphs.

It is essential to start off with a loudspeaker which has been specially constructed or "doctored" to give it a low natural cone resonance, usually in the vicinity of 20cps. Putting it in a small box will increase this figure quite markedly but, even if it more than doubles, to, say, around 45cps, it will still not be high enough to "colour" the bass response unduly.

On the surface, the answer seems too easy: Just get a speaker, load its cone or free its suspension to get a low resonance and you're in business. Not quite!

In a small enclosure, there won't be room for anything more than an 8-inch or, at most, a 10-inch speaker. Assuming a "soggy" kind of cone surround, the active cone area will be a lot less again than the frontal area of the frame.

If this speaker is to deliver reasonable output down to 45 cps, then the cone excursion is going to be quite large. But, with the usual short voice coil, too much cone excursion will carry it away from the magnet gap, leading to distortion on the peaks of every half cycle.

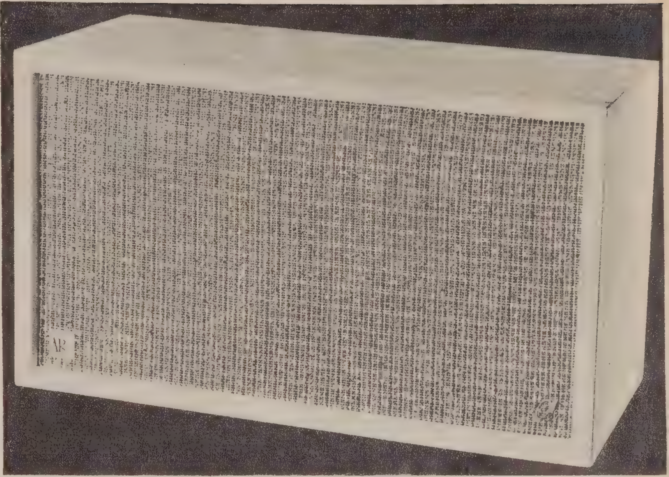
SPECIAL SPEAKER

So a special breed of speaker is necessary—one with a heavy, low resonance cone, with a long voice coil winding, and with a suspension system which will withstand large cone excursions and yet be linear in its restraining forces on the cone.

Because only a portion of its long voice coil will be in the magnetic gap at any instant, the sensitivity of such a speaker will normally be low by comparison with other types. It may or may not be capable of reproducing the whole range of frequencies.

Much argument is proceeding also, at the moment, about the inside of the small enclosure. Should it be padded but otherwise occupied only by air? Should it be stuffed with absorbent material and, if so, what material?

SMALL SIZE "INFINITE BAFFLE"



The Acoustic Research AR2, acoustic suspension loudspeaker system mentioned in the text. Four speakers are included behind the fret, the overall dimensions being 13½ inches high, 11½ deep and 24 long. The manufacturer's curve suggests a response which is level within plus and minus 3db from about 40cps to 15Kc. (Acoustic Research Inc., 24 Thorndike Street, Cambridge 41, Mass., U.S.A., or Hodges Sound Systems, 126 Buckingham Street, Sydney.)

Each idea has its supporters.

And what, you may wonder, brought on this sudden interest in compact enclosures? The answer is simply that one of our advertisers recently made available for test a pair of American AR2 enclosures, designed to give big sound out of a little box. One of the enclosures is pictured herewith.

Mounted in the front face, and behind the grille cloth, are no less than four speakers—a 10-inch woofer, two 5-inch mid-range speakers and a tweeter. The last three are sealed off at the back and only the woofer has the benefit of the enclosure.

by Neville Williams

But, noting the dimensions and the space occupied by the other speakers, the effective enclosure volume cannot be more than about one cubic foot. And this space is packed, so I am told, with rock wool.

How does it perform? Amazingly well. The bass resonance, as judged in an ordinary listening room, sounded to be at 45cps but it seemed capable of pumping a lot of air about down to some 25 or 30cps.

Above the bass resonance, the response was as smooth as any ordinary enclosure speaker in a room and, over the middle and top range, it was among the smoothest we have heard.

On musical tests, a pair of the systems was perched on top of a couple of standard vented enclosures containing high quality 12-inch speakers. There was very little to choose between them, in terms of general balance and low frequency output.

Drums, organ and double bass lost little or nothing from the small boxes.

SENSITIVITY DOWN

But the designers had paid the price in another way, as expected. Compared with the big speakers, the level on the smaller systems was down by at least 6db, perhaps more; it is difficult to judge by ear. To perform the tests as above, the volume knob had to be turned appropriately with the changeover switch, to maintain the same listening volume.

But I imagine that this can be reckoned a small price to pay for the gains in terms of frequency response. If one can't use big enclosures, there's usually no great problem in providing the margin of amplifier gain and output necessary to compensate reduced sensitivity. In fact, my "Playmaster" outfit had plenty of both, anyway!

No, I haven't traded my present enclosure for the small ones. I like the look of the big ones and I like their sound a trifle better. But the difference is marginal, not abysmal.

You can indeed get big sound out of little boxes!

One thing I must emphasise, however. You can't get big sound out of any little box and any speaker. The ones I have

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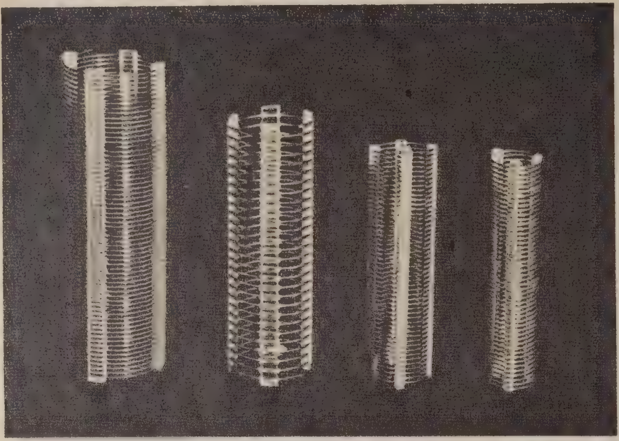

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been talking about have been designed as a system and, very obviously, "tailored" to get just the right resonance, just the right sensitivity and just the right frequency distribution between speakers.

So there we are!

As I said at the beginning, the old maxim suggests that there's no real substitute for cubic feet. Perhaps there is but it involves a lot more than mounting a speaker you fancy in a box that someone has suggested. It involves the mating of speaker(s) and enclosure to produce a designed, composite system.

Meanwhile, various engineers and inventors have broken completely with the traditional loudspeaker-cum-baffle idea, to seek some other solution. As yet, they have met with only indifferent success.

ELECTROSTATIC TYPES

Best known among their efforts is the all-range electrostatic loudspeaker. As the name suggests, it is an electrostatic unit identical in principle to the tweeters which have appeared quite cheaply on the local market; the difference is that the whole works have been scaled up to permit the unit to propagate middle and low frequencies as well.

Because the drive is distributed over the whole cone area, it is possible to have a large active cone, without having to maintain the mass and stiffness necessary when such a cone has to be driven by a single voice coil of limited dimensions.

Those who have heard the all-range electrostatic speaker under optimum conditions have been very impressed by the performance. But there are difficulties: Problems of suspension and insulation are very acute; power handling capacity is limited; propagation at the higher frequencies is extremely directional; amplifiers don't like the highly capacitive output load.

In short, the future of the all-range electrostatic is far from secured.

Then, on page 100, is illustrated an idea that is currently being boosted in the U.S. I refer to the "Bi-Phonic Coupler." This involves a stiff, wooden panel being vibrated by a conventional moving coil type of motor. The rear panel apparently vibrates by reason of the air trapped in the intervening space. Hence (I presume) the name Bi-Phonic Coupler.

LAVISH CLAIMS

The manufacturers make lavish claims about the performance, but I don't at all like the sound of their sales story. It proceeds on the basis that musical instruments use wooden panels, often craftsman-polished wooden panels; and who has ever seen such an instrument fitted with a baffle board?

Unfortunately, such reasoning, while it sounds impressive to the uninitiated, ignores the fact that musical instruments use such woodwork to help create their particular sound structure. Once created, such sound should not be further modified.

A loudspeaker should, conversely, be as acoustically neutral or "colourless" as possible. It should NOT employ techniques which help to give violins or pianos, or anything else their "glorious tone colours."

To do so would be rather akin to insisting upon red goggles, through which to view the scenery. They might do some rather startling things to sunsets, but I don't imagine that green fields and blue sky would look so good.

Last but not least comes a report from London about a new type of cheap enclosure, which gives high fidelity reproduction. It is credited to Mr J. Gough, of Cardiff, and Professor Frank Landgrebe, of the School of Pharmacy there, but neither knows just how it works. One says that it was evolved "from subconscious data recorded mentally over many years."

That sounds pretty vague and the further explanation is only a little better: "A toroid of air which will resonate at any and all frequencies, with the loudspeaker connected across the tips of it."

According to reports, loudspeaker and cabinet manufacturers and the B.B.C. have all expressed interest in the device, but this may mean very little in practice.

One might remark that "toroid or no, the claims have a familiar ring."

A REVIEW OF SACRED RECORDS

SING A SPIRITUAL WITH ME, Tennessee Ernie Ford, with accompaniments arranged by Jack Fascinato. Mono, Capitol T 1434.

With instrumental backing, and a semi-professional chorus, Tennessee Ernie Ford presents 14 Negro spirituals in much the same pattern as his recent "Sing A Hymn With Me."

For the most part, they are whooped along in rollicking style with a variety of interjections (That's fine singin', etc.). The singers don't actually clap their hands, as depicted on the cover but not, I imagine, because they didn't want to!

As to the record's appeal, I'll have to leave the decision to you. If you like the idea of rhythmic, community-style spirituals, you'll certainly enjoy the disc. The arrangements, within the prescribed format, are excellent and the recording quality first rate.

* * *

THE WORLD IN REVIEW, Excerpts from 16 "WORD" LP Discs. Mono, Word WLPD-1.

This is a "sampler" record from Word (not World) Records, Texas—an imported American pressing distributed in Australia by the Gospel Film Ministery.

Like most samplers, it is difficult to comment upon because, by its very nature, it lacks any real common denominator. In this case, the tracks (16 in all) range in content from excerpts from "The Seven Last Words" and "The Crucifixion" through electronic organ solos and gospel songs, to the Bison Glee Clubs "Battle Hymn Of The Republic" and "Roll, Jordan, Roll."

Your use for the disc, I would say, will be in direct proportion to the catholicity of your taste in religious music. If you like variety, you'll certainly get it here.

Technically, the recording quality throughout is good, average mono.

* * *

NORWOOD CITADEL BAND and SONGSTERS, Keith Francis, Bandmaster; Howard, Cowan, Songster Leader, Mono, Gem, GEM-18.

The Norwood Citadel Band and Songsters, featured in this disc, are apparently well known in Adelaide, having been established as a group for over 50 years. The items presented are typically Salvationist and will have an automatic appeal to many as a result, particularly at the economy price.

But as pure audio, the record has limitations. For the most part, the band sounds constricted, by present-day recording standards due mainly, I think, to limited treble response.

The interspersed choral items on the other hand, have notably better presence and definition, but the harmony is not always above reproach.

The surface on one side is a trifle "prickly," to borrow a word from my confrere, Julian Russell.

* * *

WELLINGTON CITADEL BAND, Salvation Army, New Zealand. Bandmaster, Bruce Parkinson. Mono, Gem, GEM-13.

On the same "Gem" label and at the same economy price, this recording of the Wellington Citadel Band represents excellent value for anyone interested in this class of music.

In a varied program of march, meditation and musicianship, the band aquits itself extremely well.

Among the titles are the "Deliverance," "Liberty" and "Red Shield" marches, "Minuet From Quintette in E," "Melody In A-Flat" and the well-known tunes "Lloyd" and "Spirit Of The Living God."

Technically, the recording is good. There's a trace of background noise, to be sure, but not enough to cause any real worry. More important, the sound is clean at all levels and in all tracks.

* * *

I'M NOT ALONE. The White Sisters. Mono, 7-in EP, GFM (Gospel Film Ministry) 1009-25 EP.

I gave these girls quite a build-up last month for their near-perfect close harmony and the precision of the musical arrangements.

If you didn't feel like buying the full LP disc, this 7-inch EP gives you half a dozen typical numbers: "I'm Not Alone," "Above All Else," "Jubilee," "Count Your Blessings," "Wonderful" and 'Now I Belong To Jesus." Recording quality excellent.

IN VARIED MOOD

PARDON MISS WESTCOTT with Peggy Mortimer, Neil Williams, Thomas Tycho and the ATN Concert Orchestra. Mono, Radiola 1501.

Pardon Miss Westcott" is billed as Australian Television's first Musical Comedy. It was written by the same team who produced the successful stage presentation, "Lola Montez."

Set in early Sydney, it tells the story of a minor misdeamounor who makes good in the colony but who finds herself up against the stigma of having once been a convict.

Being otherwise engaged, I didn't see the television presentation, but the record makes quite interesting listening. Here and there, the singers wander off pitch, probably because of the unfamiliar melodies, but orchestral arrangements and playing are uniformly excellent.

Technically, the disc is well recorded.

"FAVOURITE STORIES FOR CHILDREN, narrated by Paul Wing with Orchestra under Norman Leyden and Russ Case. Mono, R.C.A. Camden CAH—48.

There's no two ways about this disc—it's a "must" for every doting parent, grandparent, uncle or auntie.

With lively narration by Paul Wing, and appropriate chords and sound effects, nine favourite stories are ready and waiting to fascinate the young and the not-so-young.

I remembered "The Brave Tin Soldier" from my very first school primer. Then there's "Puss In Boots," "Tom Thumb," "The Ugly Duckling" and other familiar titles culminating in "Pee-Wee the Piccolo," a tale involving all the instruments of the orchestra.

Come on now! You owe it to the kids, and you'll enjoy it too. And, in case you're worried, the recording quality is excellent.

* * *

LOVE AND MARRIAGE, the Ray Charles Singers. Stereo, Festival Top Rank FST-11078T.

I thoroughly enjoyed this record also, but not just because I'm getting older and a little sentimental. The facts are:

(a) The numbers are well chosen, bright and tuneful.

(b) The Ray Charles singers, with varied accompaniments, present them in a most accomplished manner, and

(c) The recording quality, from start to finish is of the very highest standard.

"Love and Marriage" is the theme and the opening number. "The Girl That I Marry," "Let's Fall In Love," "Love Is A Many Splendoured Thing," "To Have And To Hold" are among the remaining 11 numbers.

I can recommend the stereo version. I imagine the mono would be just as good in its own class.

* * *

DANCING DOWN BROADWAY, Ralph Flanagan and His Orchestra. Mono, RCA Camden CAM-50.

Popular selections from "South Pacific," "Oklahoma," "State Fair," "Carousel," "Allegro" and "Kismet" form the basis for this dance tempo disc.

Ralph Flanagan doesn't deal here in the soft and dreamy; brass with an edge sets the mood most of the time.

I have no quarrels with the disc technically. It's good, clean mono, with no background noise and excellent definition.

* * *

LOOK FOR A STAR, Billy Vaughn. Stereo, London SAHA. 7532.

Teenagers in the household assured me that "this is a good record," which meant that they liked the playing and they liked the numbers.

Personally, I had reservations because, while some of the selections on the outer tracks are fine ("He'll Have To Go" for example) others on the inner tracks don't sound the best on a wide range system.

But that's the difference between listening to the tunes and listening to the sound!

The titles: "Look For A Star," "Snowfall," "Mona Lisa," "Paper Roses," 'Greenfields," 'Beyond The Sunset," 'Because They're Young," "He'll Have To Go," "The Apartment," — Theme, "La Montana," "A Closer Walk," "Marta."

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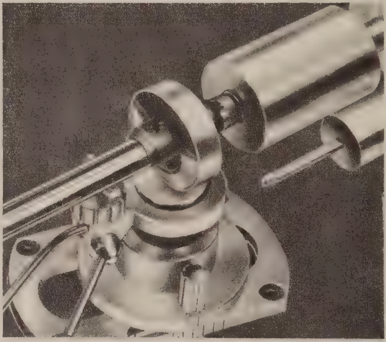

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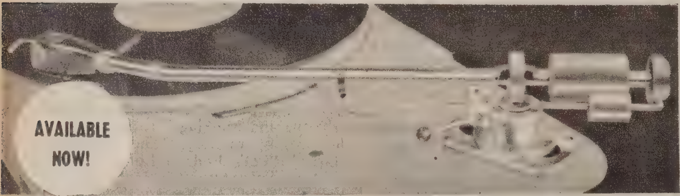

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HARMONICHA CHA-CHA, Jerry Murad's Harmonicats. Mono, Mercury MG.20391.

If you're interested in the undoubted virtuosity of Jerry Murad and his harmonica players, then you'll probably prefer one of the earlier discs reviewed in these columns—"The Harmonicats In The Land of Hi-Fi" or "Dolls, Dolls, Dolls."

In this new disc, the sound is quite heavily weighted with percussion, while variety is somewhat restricted by the "Cha-Cha" formula. But then again, you might just be looking for some Cha-Cha rhythm.

As with the earlier Harmonicat discs, the recording is of the highest standard. In fact, the combination of percussion and the electronic bass harmonica will give your speakers and enclosures a solid workout at the low end.

A stereo version is listed (SR 60061) but was not available for review.

★ ★ ★

CAESAR PLAYS, Caesar Giovannini, pianist. Stereo, Concert-Disc CS 40/6.

To make this recording, Caesar Giovannini recorded "half" of each number on the left stereo channel, then played his own accompaniment on the right channel. The effect is a duet between two Steinways, played by the one artist.

The resulting sound is "busy," forceful and assertive, with the piano tone hard and percussive. It's just the reverse of the easy, flowing style of Bill Snyder, mentioned in these columns last month.

The titles are all piano evergreens—"Dizzy Fingers," "Canadian Capers," "Stardust" and "Ritual Fire Dance," to mention four of the 13.

Possibly because of the double recording involved, the background noise is a trifle higher than is usual on this label and a slight groove echo is also noticeable. But forgetting these admittedly minor points, the recording is characterised by clean, hard sound.

★ ★ ★

THE STORY OF FLYING. Mono, 10-inch. Children's Record Guild of Australia, OXS651, JD-5.

The Children's Record Guild is connected with the well-known World Record Club. Though issued on the "children's" label, I rather felt that "The Story Of Flying" belongs to sons and fathers, rather than brothers and sisters.

The record begins with the legends of the ancient Greeks, passes to the actual experiments much later with hot-air balloons, then on to the Wright Brothers and World War I. Very soon, the listener is in the control room of London Airport, listening to the air control traffic and to a conversation with a Comet airliner.

Among the personalities featured are Group Captain Douglas Bader, Lord Brabazon, Air Vice-Marshal S. N. Webster, Group Captain Cheshire, V.C., Commander Lamb and Air Commodore F. M. F. West, V.C.

On side 2 the record takes the listener in the R.A.F. ops. room for a Hunter jet exercise, then goes on to discuss the hovercraft, guided missiles and satellites.

As I said, interesting stuff for fathers and sons.

Technically, the disc is notable for its speech clarity. In fact, the combination of "English" voices, the type of microphone and the recording characteristic at times throws sstartling sstress on the ssibilantss!

IN REVIEW—By JULIAN RUSSELL

DONIZETTI — "Freshness of Outlook"

Donizetti — Lucia di Lammermoor. Complete Opera. Roberta Peters (Lucia), Jan Peerce (Edgardo), Philip Maero (Ashton), Giorgio Tozzi (Raimondo), Rome Opera House Orchestra and Chorus conducted by Erich Leinsdorf. RCA Mono LB16255/1/2.

Erich Leinsdorf has the ability to present an opera, grown tired under the burden of cliches collected during a century of performances, as if he were meeting the score for the first time.

He discards the tiresome conventions that have drained away its vitality, insists on nervous playing, even of conventional accompaniment figures in the orchestra, breathes new life into dramatic situations that have long been frozen into static poses, and presents the whole with a freshness of outlook that even the most jaded should find beguiling.

He accomplished all this in Puccini's "Madam Butterfly" released by RCA early last year, and repeats his success in this performance of Lucia. And he again uses in the principal roles, singers who, though of undoubted merit, do not own reputations that have become a by-word among opera lovers.

Jan Peerce, of course, needs no introduction, and except where he tends to tire a little towards the end, offers an admirable Edgardo, whose ardour is always controlled by excellent musical manners. Opposite him Roberta Peters sings her difficult role of Lucia with outstanding charm even if she never quite fulfils all the dramatic possibilities of the part.

As Ashton, Philip Maero would have been more successful had he been able to bring his top register into better relationship to the rest of his range. Obvious forcing of high notes makes the listener forget momentarily his successful production throughout the rest of his compass.

The smaller parts show evidence of the most careful study and ability to project its results with good tone and dramatic emphasis, and the orchestra and chorus sound as if they, too, found new inspiration in Leinsdorf's firm, yet benevolent direction.

★ ★ ★

Brahms—Piano Concerto No. 2 in B Flat Major, Op. 83. Hans Richter-Haase and the Berlin Philharmonic Orchestra conducted by Herbert von Karajan. Columbia Stereo SAXO2328.

One seldom hears conductor and soloist making so public their disagreement on the interpretation of a concerto. For where Richter-Haaser presents what is obviously a studious performance characterised by complete absence of gush, Karajan imposes on the orchestral part exaggerated inflections that would not be out of place in a cafe band.

Pulling thus in opposite directions, conductor and pianist drop the work between them at many important places in the score. And not even the great technical skill of all taking part in this curious reading can rescue it from disquieting incongruity.

The stereo sound is excellent if one ignores the prevalent tendency of sound engineers to indulge in over-reverberation. It is rich and spacious in the orchestra and outstandingly faithful in the reproduction of the piano's tone, which is always in sensitive balance with other instruments.

The only listeners likely to approve are those who agree with the forgotten critic who once described this concerto as a "symphony with piano obbligato." From that viewpoint, and that only, is Karajan's reading valid.

★ ★ ★

Beethoven—Piano Sonatas No. 31 in A Flat Major, Op. 110, and No. 32 in C Minor, Op. 111. Hans Richter-Haaser. Columbia Mono 33CX1666.

Here Richter-Haaser again displays the same scrupulous avoidance of impetuosity to be found in the Brahms noticed above. And this style is much too restrained to meet the requirements of such intensely personal expressions as Beethoven's piano sonatas. His treatment reduces the pieces almost to bold outlines of blueprints.

His manner is so restrained that much of the music's vitality is lost, though his technique is always so assured that it would be difficult to pinpoint the spots where he fails to bring the music to life. Everything is eminently correct —and dull.

The famous Arietta in Opus III promises better things until the end, where it never manages to etherialise itself in the last dying cadences. Though it rises, it gives the impression of remaining firmly tethered to the earth.

★ ★ ★

Respighi—Pines of Rome. Fountains of Rome. Chicago Symphony Orchestra conducted by Fritz Reiner. RCA Mono L16253.

These are flexible and poetic performances of this "descriptive" music. And, what might be important to your neighbours, Reiner, by keeping his pianissimos down to a whisper, can, when necessary, produce a climax which supplies plenty of emotional and dynamic contrast without intolerable pressure on the eardrums.

A setting of the volume control at the beginning of the "Fountains" that will just bring in the opening bars at a murmur will still give you all the brilliance and weight necessary to make the "Triton" gush forth like a great cascade of diamonds.

There is nothing Germanic about Reiner's reading of this essentially Italian music. It all has true southern languor and passion, without, however, cheap over-emphasis to destroy its charm. The mono sound is first-rate, especially when played on stereo equipment, though a stereo version would be nice to hear. It might relate the weight of string tone better to the rest of the orchestra in some of the more forceful passages.

★ ★ ★

Mendelssohn—Symphony No. 3 in A Minor, Op. 56 (Scottish). Overture, Scherzo and Wedding March from the Incidental Music to A Midsummer Night's Dream. Sudwestfunk Orchestra of Baden-Baden conducted by Edouard Remoortel. Vox Mono APL11310.

Remoortel's attitude to Mendelssohn's music is refreshingly respectful, displaying none of the younger generation's condescension to this highly polished, if sometimes glib composer. Yet neither orchestra seems to respond generously to his fresh-minded direction.

The timing of the ensemble is sometimes fractionally out and the rhythm, though well-paced, just lacks the stress that would have vitalised its pulse. These lapses gain prominence by their proximity to passages that are played with great charm, and occasionally exuberance.

Remoortel's tempos in the "Scotch" are orthodox, but you will find some in the Midsummer's Night's Dream music that might surprise you. The March, for instance, goes at a quite unusual bat, and the Scherzo oscillates disconcertingly without ever really settling down to a steady pace.

The orchestral tone varies considerably in both works. That in the Midsummer Night's Dream is stringy and tough while in the "Scotch" it is richly satisfying. I think the Boult version, which couples the Scotch with the Italian, is much to be preferred, but it might still be wise to wait for a good stereo which may appear in the near future.

★ ★ ★

Purcell — Ode for St. Cecilia's Day. April Cantelo (soprano), Alfred Deller (counter-tenor), Peter Salmon (counter-tenor), Wilfrid Brown (tenor), Maurice Bevan (baritone), John Frost (bass). The Ambrosian Singers and Kalmar Chamber Orchestra conducted by Michael Tippett. Pye Acclaimed Series LLC5014.

This new Pye label was devised and produced by Pye's Australian staff. The series, according to the sleeve notes, "is dedicated to records of outstanding interest and quality which have gained universal acclaim for their beauty and brilliance."

The first example is indeed impressive. First there is Tippett's admirable direction of the work as a whole. He manages the difficult balance of the music's many component parts with skill and sensitivity.

The soloists sing stylishly and without English oratorio mannerisms. Among them is counter-tenor Alfred Deller at his best (how often one finds oneself writing that phrase about Mr Deller) and tenor Wilfred Brown join-

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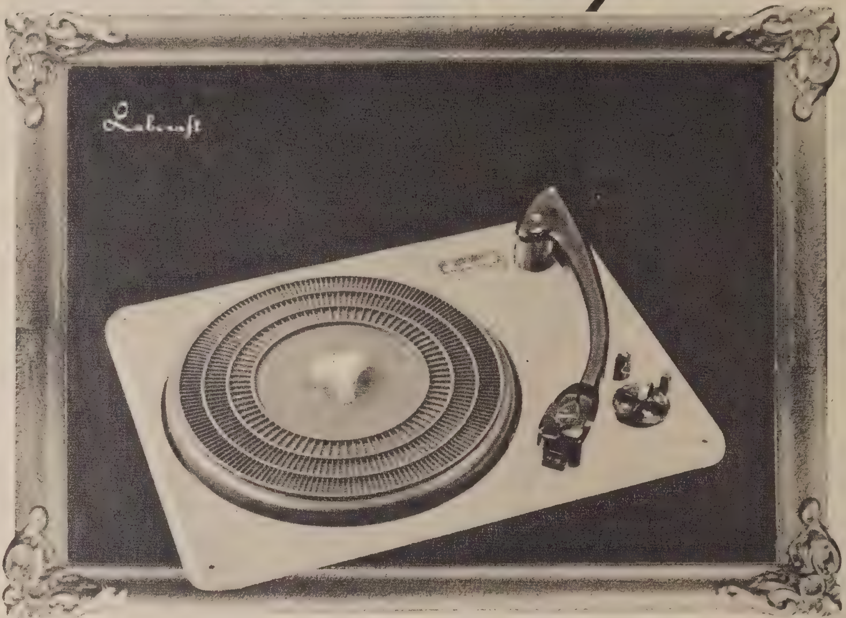

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ing him in exquisite contrasts of timbre. Miss Cantelo, too, contributes generously, always in faultless taste.

The editing of Purcell's score by Mr Tippett and Walter Bergman is consistently excellent. On the debit side, however, is some hard-to-make-out diction from the choir—the soloists' is excellent —which a copy of the text would have made seem less important.

But Purcell-lovers will, I feel sure, be happy to ignore this minor shortcoming, and others who meet this delicious work for the first time might be more than content to imitate them.

The sound is first rate, though the work was recorded in 1957.

* * *

Tchaikowsky — Piano Concerto No. 1 in B Flat Minor, Op. 23. Aldo Ciccolini and the French National Radio Orchestra conducted by Constantin Silvestri.

Liszt — Mephisto Waltz. Aldo Ciccolini. H.M.V. Concert Classic Mono OXLP 20013.

Tchaikowsky — Symphony No. 5 in E Minor, Op. 64. Nordwestdeutsche Philharmonic Orchestra conducted by Wilhelm Schuchter. H.M.V. Concert Classic Mono OXLP20009.

Beethoven — Symphony No. 6 in F Major Op. 68, (Pastoral). Paris Conservatoire Orchestra conducted by Carl Schuricht. H.M.V. Concert Classic Mono OXLP20012.

Beethoven — Concerto No. 5 in E Flat Major, Op. 73 (The Emperor). Jakob Gimpel and the Berlin Philharmonic Orchestra conducted by Rudolf Kempe. H.M.V. Concert Classic Mono OXLP20004.

Dvorak — Symphony No. 5 in E Minor, Op. 95 (From the New World). Nordwestdeutsche Philharmonic Orchestra conducted by Wilhelm Schuchter. H.M.V. Concert Classic. Mono OXLP20014.

Ballet Music from Faust (Gounod), Coppelia (Delibes) and Sylvia (Delibes). L'Orchestre de l'Association des Concerts Colonne conducted by Pierre Dervaux. H.M.V. Concert Classic Mono OXLP 20005.

I have bracketed these discs together because they have much in common. They are the first issue of a new E.M.I. "inexpensive" label that sells at 39/6, and at that price, despite their faults, offer, in most instances, very good value.

All the works are available in other versions which connoisseurs might find more to their liking but would have to pay much more to acquire.

In the Tchaikowsky Piano Concerto the sound is much too resonant for my taste and without much depth. A good bass boost is necessary to establish a satisfactory balance. The soloist offers a fluent if never very beguiling performance. In the Mephisto Waltz he forces he music to conform to his highly individual ideas of tempos. The piano one is clearer in this than in Concerto.

In Tchaikowsky's Fifth Symphony he sound is slightly improved but still no great shakes by modern standards. The violins are consistently outplayed n the climaxes and odd tempos offer little in the way of interpretative originality to compensate for their strangeness and lack of vitality.

The sound in Beethoven's Pastoral is clean but a little hard. And a rigidity of pulse matches the orchestra's never very attractive tone. This is a work that must be stroked into life, not driven, as sometimes happens here.

Gimpel uses uneven tempos in his Emperor Concerto, though his performance admittedly has a good deal of pianistic brilliance. But those who like Beethoven "neat" will be irritated by the pianist's apparent feckless treatment of the score, however much they admire the conductor's exemplary accompaniment. The sound in this is good average.

Preferred The Real Thing:—

A series of experiments in which listeners were given the opportunity to rate various types of stereo systems was described recently by Harwood B. Moore, of the General Electric Co., Utica, N.Y.

Various types of stereo and partial stereo, including regular stereo systems with two distinct channels, satellite systems with mixed bass, and single-cabinet stereo systems, were used in the experiments.

Though nothing startling came from the experiments, many high-fidelity afficionados had their previous opinions confirmed. The listeners almost unanimously preferred the true stereo over all other systems. And the closely placed speakers of the single-cabinet systems gave the listeners less feeling of stereo than any of the others.

The sound is good, too, in Dvorak's New World Symphony, with perhaps a trifle too much emphasis on the bass. But despite occasional bursts of exhilaration, the general climate of the performance lacks the true Czech lilt that conductors of that nationally seem always able to win from their orchestras.

The Ballet Music disc is, I think the best of all. The playing is as consistently bright as the sound and if you're looking for a first-class bread-and-butter version of this attractive music you will find it here at a bargain price.

* * *

Tchaikowsky — Violin Concerto in D, Op. 35. Henryk Szeryng and the Boston Symphony Orchestra conducted by Charles Munch. R.C.A. Mono L16243.

This performance, though not without its faults, must be placed among the most desirable at present available on disc. Szeryng has a dazzling technique which he may appear to use effortlessly in a concert hall. Here, however, his proximity to the mike makes more obvious the effort necessary to bring off his many brilliant adventures.

And this fault does not intrude occasionally but runs consistently through the whole work — with the exception of the exquisite pianissimos in the slow movement. Concentration on contrasting the fast and slow sections of the Finale betrays Szeryng into interrupting the movement's musical thought.

I could recommend it with more enthusiasm if Ferras' performance was not on offer at the same time.

Brahms—Violin Concerto in D Major. Isaac Stern and the Philadelphia Orchestra conducted by Eugene Ormandy. Coronet Stereo KLCS2734.

This is a grand performance by both soloist and orchestra, splendidly recorded. Stern's technique enables him seemingly to concentrate his full attention on the interpretative problems, which, some details in the slow movement excepted, he solves with brilliant success.

This is not to be taken as meaning that the slow movement could be regarded as "faulty" by any but the most carping of critics. And many admirers of the work may like Stern's idea of taking the end of it rather slower than the opening tempo, for Stern's reading throughout is never less than logical.

Moreover this is obviously a concerto that Stern both loves and understands, that he finds a rewarding vehicle for the display of his very great musical intelligence. I am not being facetious when I say that he sternly refuses to be side-tracked from the work's main thought

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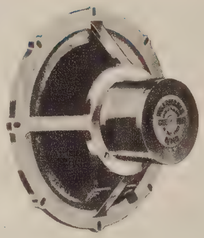

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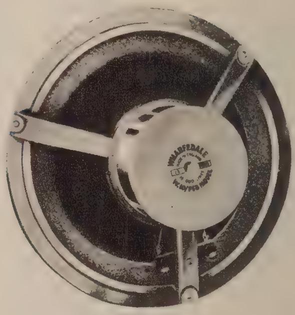

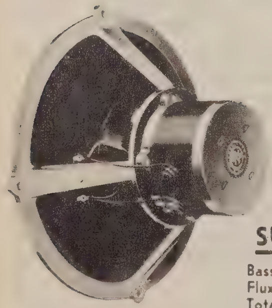

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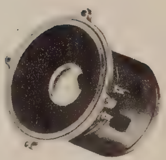

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His reading is very much in the grand manner and one that I can recommend without hesitation to all those on the look-out for the best stereo version available at present. My pressing favours the soloist ever so slightly, occasionally, but never to an extent that obscures the orchestra. No mono version was available for review.

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* * *

Grieg—Piano Concerto in A Minor, Op. 16. Clifford Curzon and the London Symphony Orchestra conducted by Oivin Fjeldstad.

Franck—Variations Symphonique. Litolff — Scherzo from Concerto Symphonique, No. 4, Op. 102. Clifford Curzon and the London Philharmonic Orchestra conducted by Sir Adrian Boult. Decca Stereo SXL2173.

I can recommend this Grieg enthusiastically, too, though there are other versions which some listeners may prefer. Curzon adds a beautiful rhythmic bounce to his eminently poetic reading yet manages to restrain the whole within the rather narrow framework to which it is best suited. He never inflates it, as Cziffra does, nor seeks to make it, like Cziffra, a means of advertising his undeniable virtuouso attainments.

His reading comes closer to Solomon's (my favourite) than any other I have heard and many discophiles may like Curzon's account even better. There are moments when he is ever so slightly more forceful than Solomon, an aspect of interpretation that is essentially valid and will doubtless attract many admirers.

I can find no praise too high for the accompaniment provided by Fjeldstad and his orchestra. The fact that the conductor is a Norwegian might explain his obvious love and understanding of the score and the perfection of his co-operation with the pianist.

The Franck is admirable, too, but in this my preference goes without qualification to another version — Casadesus' for R.C.A. The margin, however, is admittedly small and might be influenced by the couplings if I had to make a choice. Casadesus uses the d'Indy "Swiss Mountaineer's" Symphonie on the reverse. Solomon, by the way, couples his Grieg with an incomparable performance of the Schumann A Minor Concerto.

To fill his generous disc, Curzon adds a brilliant performance of the Scherzo from Litolff's Concerto Symphonique No. 4 which is easily the best available at present either in mono or stereo.

Rachmaninoff — Rhapsody on a Theme of Paganini. Dohnanyi — Variations on a Nursery Tune. Julius Katchen and the London Philharmonic Orchestra conducted by Sir Adrian Boult. Decca Stereo SXLA2176.

This is a new recording of these two works and not to be confused with the mono disc by the same artists issued some five years ago. It retains all the many fine features of the older record with the added benefit of two-channel reproduction which improves the balance between pianist and orchestra considerably.

Katchen is, in my opinion, unique among the younger pianists in combining brilliance of digital agility, which nearly all of them have, with a sensitive appreciation of the music of the romantic period which many of them lack. And he accomplishes this without gush or self-advertisement.

He is partnered to perfection by Boult and the London Philharmonic, and except for the slightest of prickles on the surface of my pressing, this might well be described as the definite recording of these two works.

* * *

RECOMMENDED

Tchaikowsky — The Divine Liturgy of St. John Chrysostom. Cathedral Choir of the Holy Virgin Protection Cathedral of New York City conducted by Nicholas Afonsky. Westminster Mono WG-W-18088.

Beethoven—Piano Concerto No. 1 in C Major, Op. 15. Piano Concerto No. 2 in B Flat Major, Op. 19. Emil Gilels and the Paris Conservatoire Orchestra conducted by Andre Vandernoot. Columbia Mono 330CX1667.

Bach — Brandenburg Concertos Nos. 1, 2 and 3. Yehudi Menuhin, Elaine Schaffer and George Malcolm and the Bath Festival Chamber Orchestra conducted by Yehudi Menuhin. HMV Mono ALP1755.

Mendelssohn — Violin Concerto in E Minor, Op. 64. Bruch—Scottish Fantasia, Op. 46. Alfredo Campoli and the London Philharmonic Orchestra conducted by Sir Adrian Boult. Decca Stereo SXL2026.

Brahms — Quintet in B Minor for Clarinet and Strings, Op. 115. The Fine Arts Quartet with Reginald Kell. Concert-Disc Stereo CS-202/23.

Walton — Quartet in A Minor. Villa-Lobos — Quartet No. 6 in E Major. The Hollywood String Quartet. Record Society 10-6010.

Ralph Downes — Organ Recital. Widor — Toccata in F Major. Bach—Partite Diverse (11 Variations on "Sei Gegrusset, Jesu Gutig." Fugue a la Giga. Toccata and Fugue in F Major. Pye Stereo CSCL70006.

Rita Streich Sings Songs by Schubert. DGG Stereo SLPM1338047.

Beniamino Gigli with orchestra in Italian operatic arias and songs. RCA Mono L16238.

Ezio Pinza Sings Italian Songs. RCA Camden CAM34.

Geraldine Farrar in 11 Excerpts from Bizet's Carmen, with Giovanni Martinelli. Metropolitan Opera Orchestra and Chorus. RCA Camden CAM32.

Shostakovitch — Symphony No. 5, Op. 47. New York Philharmonic conducted by Leonard Bernstein. Coronet Mono KLCS2715.

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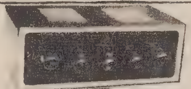

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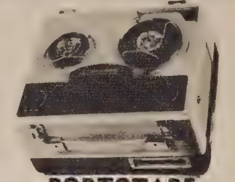

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AMATEUR BANDS WITH BILL MOORE

WIA NATIONAL FIELD DAY

Each year we see more and more amateurs actively participating in, and by so doing enjoying the annual field day. It is hoped that this year will be no exception and the usual spirit of friendly contest will prevail over the second weekend in February.

THE WIA's National Field Day for 1961 takes place over the weekend Saturday, Feb. 11, and Sunday, Feb. 12 —Hours of operation, Saturday, 1800 to 2300 hrs., Sunday, 1000 to 1600 hrs. E.A.S.T. There are five sections of the contest.

(a) Portable/Mobile Transmitting Phone.
(b) Portable/Mobile Transmitting C.W.
(c) Portable/Mobile Transmitting Multiple operators, Open only.
(d) Fixed Transmitting Stations working Portable/Mobile Stations, Open only.
(e) Reception of Portable/Mobile Stations.

RULES

Mobile or Portable Stations shall be limited to an input of 25 watts to the final stage. This power shall not be derived from public or fixed mains. They shall not be located within a mile of the home of any operator or in any occupied dwelling.

No apparatus shall be set up on the site selected earlier than 24 hours prior to the contest.

One contact per station for phone and one for C.W. shall be permitted.

Serial numbers must be exchanged, the usual RS or RST plus three figures.

SCORING: For Portable/Mobile Stations. For contacts with other P/M stations, outside entrant's call area—15 points. For contacts with P/M stations in same call area—10 points. For contacts with fixed stations, outside call area —5 points, within call area—2 points.

For fixed stations:

For contacts with P/M stations outside entrant's call area—15 points, within call area—10 points.

The following constitute call areas — VK1 (A.C.T.), and VK2 combined, VK3, VK4, VK5, VK6, VK7, VK8, VK9 and VK0.

The usual log and front sheet must be submitted.

All entries must be addressed to the Federal Contest Committee, WIA, Box 371B, G.P.O., Hobart, Tasmania.

Certificates will be awarded to the highest scorer in each section in each call area. The above is a summary of the rules only.

Vic. Spring convention

THE Geelong Amateur Radio Club were the hosts for the 1960 Spring Convention of the South West Zone of the Victorian Division. Attendance was down a little on previous events as most country amateurs are very busy at this time of year. Members were welcomed at the club rooms in Cheringhap Street during the afternoon and were served with refreshments. Bill Brownhill, VK3BU, set up his new transmitter (geloso type) in the club premises and contacted Bill Dennis, VK3XE, Brian Alexander, VK3ADV, and Zone President Kevin O'Rorke, VK3AKR, among others on their way in.

Among the visitors was one-time Zone secretary Bill Zimmer, VK3AWZ, who brought his family down from Melbourne.

After dinner at the Delphie Cafe the Zone meeting was held in the clubrooms with President Kevin O'Rorke, VK3AKR. Jim Barber, VK3ABT, WICEN Zone officer reported on net activity and it was decided that the WICEN operators should elect their own officers and manage their own affairs. On the following morning the election was held.

The evening concluded with the presentation of two lecturettes, one by Dick Heighway, VK3ABK, who described his 1296 Mc equipment, the other by Peter Ward, VK3ZAV, who discussed 1296 Mc techniques and the "Moon Bounce" project. The WICEN elections saw Jim Barber, VK3ABT, appointed as Zone WICEN Co-ordinator and Zone Control Station. The Eastern Group elected Bill Brownhill, VK3BU, as group control and Southern group Don Baulch, VK3AKN, to a similar position.

FIELD EVENTS

The field events were well supported and the winners were as follows:

Best HF DX worked — Brian Alexander, VK3ADV.

Best VHF DX worked—R. Wilkinson, VK3ZER.

Best Mobile Rig — Gordon Vincent, VK3AGV.

80-metre Transmitter Hunt — Brian Alexander, VK3ADV, who was awarded the Geelong Amateur Radio Club's trophy. Brian also proved too good and won the All Band Scramble.

Peter Ward, VK3ZAV, won the prize for naming the valves which were listed as VT25, 6AU6, 8OS and 2A4G.

The Zone's Convention was a great success and the Zone had been awarded the Kinnear trophy at the State Convention held two weeks before.

HAM INGENUITY ON 1296 Mc

ONE of the most interesting stories of amateur ingenuity was told by Sam Harris, W1FZJ, QST, VHF Editor and Moon Bounce specialist. It concerned frequency stability for both transmitter and receiver and how it was obtained for Moon Bounce working. Originally Freddy Mauer, HB9MS, was talked into designing a transistorised crystal oscillator and the preblem of temperature control then solved in a simple manner. This type of control is available to any amateur who lives where there is bare ground.

The transistorised oscillators, complete with crystals, were enclosed in fruit juice tins and soldered shut. The tins were then mounted in large mouthed vacuum bottles and sealed shut with beeswax. The output from the oscillator was taken by means of co-ax cable. The whole device was buried approximately 6 feet deep where temperature varies little throughout the year. The oscillator was battery powered keeping it independent of line fluctuations and with temperature control provided by Mother Earth an equivalent was obtained of an oven that no money could buy.

Both transmitter and receiver oscillators were treated in a similar manner with stability in the order of one cycle at 1296 Mc available. The whole project cost 15 dollars plus some labour. Other factors such as crystal aging, etc. can affect absolute frequency stability but short term stability measurement indicated an accuracy in the order 10 to the -10th.

MARS operation

THE Armed Services of many countries conduct special reserves in which Radio Amateurs operate and so become acquainted with service procedure and organisation. The Amateur Service provides a group of trained persons that have in the past proved invaluable in time of emergency and are encouraged in their work by different branches of the Forces.

All sections of the Armed Services in the U.S. conduct special reserves by which U.S. amateurs can participate in Service activity in varied ways. The Naval communications Reserve is one phase of such activity. Perhaps the best known organisation to VK's is Mars—Military Affiliate Radio System sponsored jointly by the U.S. Army and U.S. Air Force.

ELIGIBILITY

Membership in Mars is available to anyone over 16 years who holds a F.C.C. Licence and can operate on two Mars frequencies.

Membership is on a voluntary basis, the volunteer agrees to participate in at least six hours Mars operation each three months, generally arranged in hour sessions and provides no hardship to the average amateur. Mars members are provided with an attractive certificate and disposals equipment is made available for experimentation and cannibalisation. Members also qualify for special extension courses conducted at the U.S. Army Signal Corps School or the U.S. Air Force Institute. The courses cover such subjects as mathematics, antennas, wave propagation, VHF techniques, etc. Six months of active membership are required before courses or equipment are made available. The member uses special military frequencies set aside for Mars station frequencies and can expect to hear professional operating techniques on these channels. Mars Membership is also available to serving personnel and practically every military station has its own Mars equipment in operation.

VALUABLE BENEFITS

Perhaps the most important benefit available to members is participation in a fully organised emergency organisation prepared and ready for operation in any civil or national disaster. The record of Mars stations in flood and hurricane is a creditable one.

Membership is also available to the YL or XYL as well as OM. Mars Membership provides an interest for amateurs who have a flair for efficient operating and an affection for service equipment. It is currently estimated that the average Field Army would have some 75,000 electronic devices in operation during normal exercises. Certainly plenty of equipment to become interested in.

A recent FCC Public Notice announced the temporary use of amateur frequencies for U.S. Army Exercise South Wind held in November. The exercise involved the use of 100,000 troops and the U.S. Army Radio Office had exhausted all available Army frequencies in the 135 to 400 mc/s segment. 8 spot frequencies in the 144 mc/s band and 10 in the 220 mc/s were selected. It was not anticipated that the Army station would cause any great hardship to amateurs in the areas where stations were to be used due to the locations of the stations and the beam antennas to be used. The voluntary co-operation of amateurs was requested. An exercise of this magnitude is held only on rare occasions and the temporary use of portions of the amateur bands is a more satisfactory arrangement than the permanent loss of frequencies. The planning indicates the high opinion held of the Amateur Service in the U.S.

Extended telephony bands

CANADIAN amateurs now enjoy greatly increased telephony band allocations and follow the U.S. allocation on 14 mc/s out to 14350 kc/s. The expanded telephony allocations read as follows: 7150-7300 kc/s, 14,100 to 14,350 kc/s, 21,100 to 21,450 kc/s and 28,100 to 29,700 kc/s. The subject of the expansion was under discussion among Canadian amateurs for some time. At one stage a petition signed by some 15,000 VEs was submitted to Parliament. Finally the Department of Transport (Canadian licensing authority) conducted a poll among amateurs with three suggestions of telephony band widths and the new bands came into force as a result of the verdict of this poll. Simultaneously, the restriction that only French or English could be used for communication in the amateur bands was lifted. Now any language may be used provided the log is suitably endorsed and signed by the operator/speaker. French or English, however, must be used for station identification.

Silent keys

IT is with deep regret the passing on January 4 is recorded of Owen Chapman, VK2OC of Wyong. Owen, during the 1930s, was well known to Australian and overseas amateurs; during recent years his main activity has been directed towards municipal affairs and he served for a long period on the Wyong Shire Council. He was an ardent supporter of the W.I.A. and held office as country vice-president of the N.S.W. division for a number of terms. As local organiser with Phil Levenspiel, VK2TX, of the well-known Wyong Field Days, forerunners of the Woy Woy and later Gosford events, he met many amateurs, who admired his beautifully constructed equipment. One phase of Owen's amateur activity was crystal grinding which was to develop into practically a business, and he was an acknowledged specialist in this field. For a number of years he presented standard frequency transmissions on 7 mc/s on behalf of the N.S.W. division on Sunday mornings and at its completion provided frequency checks for amateurs.

The sympathy of all amateurs is extended to his wife and daughters.

One of the best-known of the world's DX operators, Ev, KP4KD, passed away on December 18. Ev was well known to many VKs for his excellent signals on 14 and 21 mc/s, generally arriving via the long path. He was essentially a CW man but not of the report and SK type, always enjoying a ragchew. Ev will be missed from the HF bands.

Army field exercise

WICEN operators and other amateurs in N.S.W. again co-operated with the Army in December in a similar exercise to the one conducted last August. The Army Mobile Unit on this occasion travelled a different route in the west of N.S.W. through Bathurst, Wellington, Dubbo, Gilgandra, Warren, Bogan Gate, Forbes and Cowra. The unit was from the 504 Air Support Signal Unit. The station was housed in a 2½-ton truck and aerials were erected at each location. Equipment covered all frequencies including the VHFs.

Amateurs listened to the mobile van at specified times and reported on the signals to the Amateur Control Station using VK2AUX, Blue Mountains WIA callsign. The control station in turn broadcast a summary of all signal reports for reception by Army stations. A number of amateurs in different parts of N.S.W. provided information and the Army Signals authorities expressed their thanks for the assistance provided in a letter to the N.S.W. State president, Bill Lewis, VK2YB.

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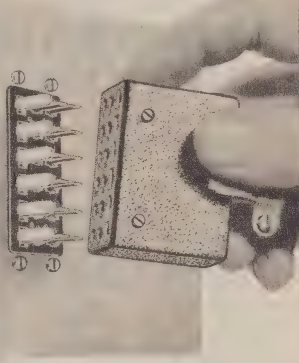

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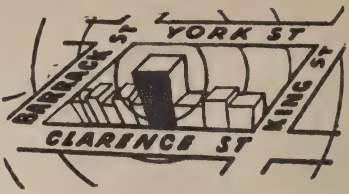

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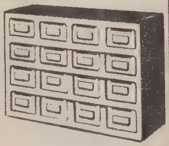

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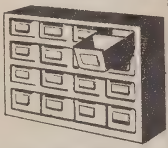
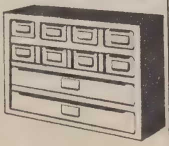
As Model A—but fitted with Divisions.



MODEL D
52/-
Cabinet 12" x 9" x 5½". 8 drawers 5½" x 2⅝ x 1½" 2 drawers 11" x 5½" x 1½".



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VHF activity

THE VHF and TV section of the N.S.W. division's 144 mc/s Christmas Scramble conducted prior to the festive season was well supported, over 30 stations participating. They were nearly all Z calls. Only five of the full calls were active. Winner of the event was Dave Andrews, VK2AWZ, who collected the majority of first placings in this and other VHF field events in 1960. Dave might collect a handicap in 1961!

The Ross Hull Memorial Contest provided plenty of interest for 50 mc/s enthusiasts in December and early January.

Openings to interstate and ZL were fairly regular. Some of the better openings were reflected on the TV screens at the time in and around Sydney. Channel 2 from Adelaide made quite an impression, ruining normal reception. The announcement from the P.M.G.'s Department that the 50 mc/s band was being again made available to amateurs, this time for an unspecified period, was welcomed by VHF enthusiasts.

The department stated that one month's notice would be given of any intention to withdraw use of the band. Some of the wishful thinkers hope the problems of channel 1 and sporadic E, etc., will see 50 mc/s retained for amateur use for many years.

O.C. VK2WI

Dave Duff, VK2EO, again takes over as officer-in-charge of VK2WI Dural from George Rutter, VK2CB, who was forced to resign due to pressure of business. The position is an exacting one, time consuming, and with plenty of work necessary to ensure the equipment is fully serviceable at all times. There is also the problem of rebuilds and modification of gear for the station. Most Sundays are spent as engineer at the station and George is to be congratulated on a job well done on behalf of his fellow amateurs.

The 25 KVA emergency power unit is fully operational and on standby. In event of any power supply failure VK2WI can be brought back on the air in under two minutes. The 16 element phased array on 144 mc/s is again in operation and will be used for general contacts, the turnstile being excited for normal broadcasts.

VK5 144 mc/s enthusiasts are beaming towards N.S.W. each evening at 2030 hrs E.A.S.T. according to a report from VK5KK.

International Fox Hunt

FOX HUNTS are a popular form of entertainment for radio amateurs throughout the world. Amateurs in some countries favour 80 and 160 metres for such activity while in others most of the hunts are run on the VHF bands. These events are very competitive but generally run only between local competitors. Scheduled to take place at Stockholm in August, 1961, is the unofficial European Fox Hunt championship. It is to be organised by the Swedish Amateur National Society, the S.S.A.

Perhaps one day we will see a similar event conducted in Australia. Around Sydney and undoubtedly in other capitals there are specialists that would need handicapping—no calls listed here.

The granting of independence to so many former colonial territories of various nations has caused the appearance of some unusual prefixes in recent months. Prefixes commencing with a letter have been exhausted. The future pattern for prefixes was originally set some years ago by Ceylon with 4S7 and Israel 4X4. Some of the latest prefixes include 9U5—Ruanda Urandi, 9N1—Nepal, etc. Provided the users of these prefixes supply a suitable gap between them and the rest of their call there will be little confusion.

If signals are down in the mud and prefix and station identification numbers and letters are run together, there will certainly be problems in identification.

SSB award

OF interest to SSB operators is the award offered by CQ magazine. Attractive certificates are available for two-way SSB contacts with a specific number of countries. Certificates for 50, 75, 100 and 200 countries can be won, with stickers for intermediate groups of 25 countries. For the "Worked 50" or "Worked 75" certificates, a list of confirmations verified by another amateur is sufficient to submit. For "Worked 100" or "Worked 200" countries it is necessary to submit QSL cards together with the listings; "To CQ Magazine — first par for P39."

Another overseas award available is the Golden City Award which can be obtained by amateurs contacting 15 ZS6 operators located in Johannesburg after May 31, 1960. The QSLs and five IRCs should be sent to the Awards Manager, P.O. Box 2327, Johannesburg, South Africa.

Awards are still on the increase and as G2BVN, RSGB DX editor puts it, with some 600 to 700 awards that can be worked for it is almost impossible these days to contact any station without the QSO counting for some award or other.

There are plenty of DX prefixes using SSB and Ian, MP4BBW's score on that mode was up to 185 countries in November. In one three-week period he tallied 464 DX SSB contacts.

Awards are the order of the day. W1WWD offers a silver cup and 100 dollars to the DX station that QSLs and brings his countries total to 250 confirmed.

Brief notes

THERE is still much general publicity being presented overseas towards the universal adoption of G.M.T. for all radio amateur purposes. The 24 hours system using G.M.T. avoids argument and misunderstandings due to local time differences.

A good start is to set the station clock to G.M.T. or, for preference, obtain one of the 24-hour variety. G.M.T. is a common language anywhere.

Another school transmitter operating on the 7 Mc band is VK3AYL. It is the station of the Melbourne Church of England Girls' School at South Yarra. It is located in the Physics Laboratory and under the eye of Harry Chapman, VK3GU, who is Physics Master there.

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Note: "T" denotes upper half track, "L" lower half track, all others full track (except H4 and EH4, which are half track).

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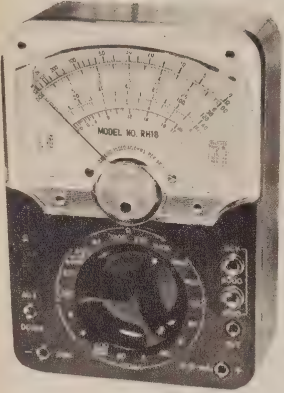

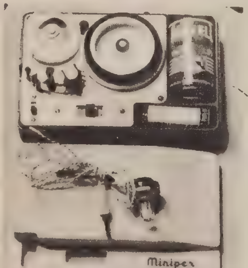

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DC Current: 0.60 uA, 0-6-60-600mA, 12A
Resistance: 0-5K-500K, 0-5Meg-50Meg (30 Ohms, 3K, 30K, 300K at centre scale)
Decibels: minus 20db to plus 63db in 5 ranges
Dimensions: (3 5-16" x 6 5-16" x 2⅞")
Weight: (29oz approx.)
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- 3" Meter
- Handy pocketable size

SPECIFICATIONS

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AC Voltages: 0-10-50-250-500-1000V (10,000 Ohms/V)
DC Current: 0-50uA, 0-5-50-500mA
Resistance: 0-10K, 0-100K, 0-1Meg, 0-10 Meg (62 Ohms, 620 Ohms, 6.2K, 62K at centre scale)
Capacitance: 0.0001uF-0.005uF
0.005uF-0.1uF
Decibels: minus 20db to plus 36db in 2 ranges
Dimensions: (3½" x 5¼" x 1⅞")
Weight: (15oz approx.)
Complete with internal battery, testing leads with prods.

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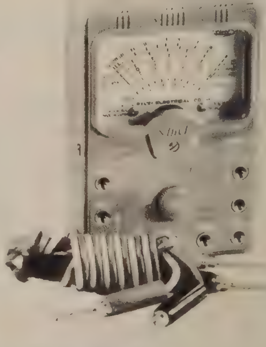
Complete ready to use —no extras to buy



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- 10,000 Ohms per Volt on AC
- 3¼" Meter
- 18 position selector

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DC Voltages: 0-5-25-100-500-1000-5000 (20,000 Ohms/V)
AC Voltages: 0-5-25-100-500-1000V (10,000 Ohms/Volt)
DC Current: 0-50 uA, 0-5-50-500mA
Resistance: 0-6K-600K, 0-6Meg-60Meg (30 Ohms, 3K, 30K, 440K at centre scale)
Capacitance: 100uuF-0.01uF, 0.002uF-0.3uF
Inductance: 20 H to 2000 H
Decibels: minus 20db to plus 30db in 2 ranges
Output Jack: for Audio measurements
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ON SHORTWAVE BY ART CUSHEN

PARIS TO FAR EAST IN ENGLISH

Paris (France) has for many years had only one transmission in English, beamed to the United Kingdom. The extension of this service in this direction will be welcomed.

THIS new English transmission from Paris is beamed to the Far East, and should give good reception in Australia and New Zealand. The broadcast is from 11.00 to 11.30 p.m., and can be heard on 21620 and 17765 Kc. This English program is additional to the only other Paris service we hear, that is, from 6.00 to 6.30 a.m. on 5960 Kc, which is for listeners in the United Kingdom. Reports on reception of this new transmission will be welcomed by Radiodiffusion Television Francaise, 118 Champs Elysees, Paris 8E, France.

Bogota on 6125 Kc

A POWERFUL signal from a station which in the past has been seldom heard, due to its use of a lower frequency, has been noted in the late afternoons on 6125 Kc. The station identifies as Radio Continental in Bogota, Colombia. The program was of typical Latin-American music, with announcements of commercial products between each item and station identification each 15 minutes. The broadcasts were formerly tuned on 4835 Kc, when the station used the callsign HJKE. Reports to the station should be sent to Radio Continental, Apartado Aereo 53-42, Bogota, Colombia.

A new station in Bogota, Colombia, which appears to now operate all night, has been tuned on 4965 Kc in the late afternoons at very good strength. The station announces as "Radio Santa Fe," and a taped announcement to this effect is given after each musical item. The station has typical Latin-American music, and the identification on a background of music is "Radio Santa Fe de Musica en Bogota Colombia." Reports should be sent to Radio Santa Fe, Aereo Postal 2469, Bogota, Colombia.

Kabul makes changes

RADIO Kabul has been heard on altered frequencies in the past few weeks. The European service from Kabul, with news in English, can now be heard from 5.00 a.m. to 5.30 a.m. on 9705 Kc instead of its former frequency of 15385 Kc. The news in English can also be heard from 12 to 12.30 a.m. on 4710 Kc. Another report, this time from Japan, says the Kabul transmitter has been noted opening at 9.30 p.m. on 7250 Kc. The station has the home service program and also carries the English news at midnight.

Reunion verifies

A LETTER of verification has come to hand from Radio St. Denis on Reunion Island in the Indian Ocean (which, incidentally, makes our 180th country verified). Radio St. Denis is operated by Radiodiffusion Francaise, and has broadcasts both for internal and external listeners. The station has been heard at 4 a.m. on 3380 Kc, with 1500 watts. The verification letter lists the new schedule, which is as follows:

12.30 to 1.45 p.m. on 4820 Kc.
6.00 to 8.30 p.m. on 4820 Kc.
Midnight to 4.00 a.m. on 3380 Kc.
Service on Sundays and holidays, 2.00 p.m. to midnight on 4820 Kc.
Midnight to 4.00 a.m. on 3380 Kc.

Verification is from J. Billaud, the chief of the Service of Radio Reunion at St. Denis, Reunion.

Transworld Radio

OUR reception of Transworld Radio (in Monte Carlo) from 4.30 to 6.00 p.m. on 9710 Kc with gospel broadcasts, has been followed with the reception of signals on other frequencies. This station has its address as 114 Wigmore Street, London W1, England, for this transmission, but gives its local address when on other transmissions. The Monaco station has been noted from 3.30 to after 4.30 a.m., when they use the frequency of 7135 Kc. Dick Pollard, of Nelson, N.Z., reports that this frequency is good, and a request for reports in this case is made to Transworld Radio, P.O. Box 141, Monte Carlo, Monaco.

New Indian schedule

THE program of All India Radio, which originates from Bombay, is now carried on new high-powered transmitters giving an extended range of reception. This new program is in Hindu throughout, and is broadcast as follows: 11.30 a.m. to 1.30 p.m. on 9590 and 7120 Kc, 3.30 to 4.30 p.m. on 11870 and 11950 Kc, 6.30 to 7.30 p.m. on 11950 and 11830 Kc, 9.00 to 10.45 p.m. on 11950 Kc, 11.00 p.m. to 2-15 a.m. on 9550 and 7260 Kc, 2.15 to 3.30 p.m. on 5955 and 7260 Kc.

Noumea using 3355 Kc

RADIO Noumea, in New Caledonia, has returned to the 90-metre band, and is heard in the evenings from 5.00 to 8.30. Using 3355 Kc, and with very strong signals, the station seems to give the impression that this is a new transmitter, possibly for use in the new programs, which are planned for 1961, when English broadcasts will be released. Signals are still heard on the other frequency, 6035 Kc, and on the broadcast band outlet of 1400 Kc.

Flashes from Everywhere

GUATEMALAN station, Radio Cultural, is on the air from 10 p.m. to 1 p.m the following day with all transmissions in Spanish. Radio Cultural uses 5990Kc. From 1 p.m. to 2 p.m., the station uses English and the callsign TGNA with Gospel transmissions broadcast on 5952 and 9660Kc.

BOLIVIAN Gospel broadcaster CP38 Radio la Cruz on 9440Kc., is to increase power from 1500 to 10,000 watts. CP38 has been heard during the winter, and this increased power will give us better reception later this year.

BRAZILIAN station Radio Farroupilha, Porta Alegere, verified after 3 years as ZYU59 on 9730Kc. 10Kw., and ZYU68 15335Kc. also 10Kw.

MOROCCAN station, Sebaa Riyoun is on the air for broadcasts to Algeria from 5 a.m. to 8.30 a.m., using 9495Kc. This station, Radiodiffusion Marocaine, is used for broadcasts in support of the Algerian Nationalist movement which also has some transmissions from Tunis under the slogan: "The Voice of Algiers."

BANGKOK in Thailand with its overseas service from 8.25 p.m. to 9.55 p.m. on 11905Kc., is reported to have English broadcasts from 8.25 to 9.30 p.m. on 7300Kc., one of the frequencies generally used for home programs.

GWELO is the location of a new 10Kw. transmitter in the Federation of Rhodesia and Nyasaland which carries

WORLD RADIO HANDBOOK—REVIEW

THE sixteenth edition is now on the market, and readers of this page will know how essential it is to world-wide listening. The new edition, published by O. Lund Johansen in Denmark, shows a further increase in information, and its circulation has risen from 2,000 copies for the first edition to over 16,000 for the 1961 edition. More than 1,000 of these are expected to be sold in Australia and New Zealand. Containing about 200 pages of information, it lists the complete details on all stations by country and continent, and also a list by frequency, with such information as schedule, identification, announcement and signal, language broadcasts, station personalities, address and other relevant details. The handbook is available from book stores handling technical publications, or from Arthur Cushen, 212 Earn Street, Invercargill, N.Z. Price is 16/6, while a brochure on the handbook is available on request.

The WARBURTON FRANKI Page

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Twin Rubber 14/0076 100yd coil £15/2/6 (per yd. 3/11)

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Two Pin Male Line, 9/-; Female Line, 9/-; Female panel, 6/-.

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the South Regional program from 2 p.m. to 4.10 p.m. and 1.15 to 5 a.m. on 4965Kc., as well as 8 p.m. to 1.15 a.m. on 9735Kc. A further 2500w station at Zamba transmits from 3.20 to 5 a.m. with English at 4 a.m. on a frequency of 3955Kc.

ADEN has an extension to its schedule, reports the World Radio Handbook bulletin, and is now on the air from 1.30 to 3.30 p.m with an extension to 8 p.m. on Sundays, and Friday 10 p.m. to 8 a.m., when using 7170Kc. The station has news in Arabic at 4.55 p.m. to 6 p.m. and 4 a.m. to 6 a.m., and at sign-off, 8 a.m.

SENEGAL, which broadcasts from a 100Kw. transmitter at Dakar, radiates the programs of the national network from 4.30 to 3.45 a.m. and from 4 a.m. to 9.30 a.m. on 11895Kc. On weekdays a special program to Europe is being broadcast from 3.45 to 4 a.m. on 15385Kc.

SUDAN, at Khartoum, in verifying a listener in Europe, states they are on the air from 2.15 to 3.30 p.m., 12.15 to 7 a.m. in Arabic on 5039, 9600 and 11750Kc.

SEYCHELLES Broadcasting Service at Mahe is operating daily, 12.15 to 2.15 a.m. on 4990Kc. with a power of 40w.

MONGOLIA has broadcasts from Ulam Bator of its home service from 9 a.m. to 2.10 p.m. and 6 p.m. to 1 a.m. in Mongolian on 5960Kc. with 50Kw, and 9575Kc. with 25Kw. The station also has broadcasts in Russian on Monday and Friday at 10 p.m., Chinese on Tuesday and Thursday at 9.35 p.m., and Kazakh on Tuesday and Saturday at 10.15 p.m. Relays are carried from Radio Moscow and these can be heard from 7.30 to 8 p.m. and 12.15 to 1 a.m.

MOROCCO, with broadcasts of Radiodiffusion in Marocaine, Rabat, has a transmission in French from 2 to 3 a.m., the frequency being 15345Kc. News is at 2.45 a.m. in this transmission, which is beamed to the Congo.

YUGOSLAVIA, with broadcasts from Radio Belgrade, now lists the English schedule at 1.30 to 2 a.m. on 9505, 11735, 15240Kc. The broadcasts from Belgrade are heard at 2.45 to 3 a.m. on 7200, 9505 and 15240Kc., and 4.30 to 5 a.m. on 6100, 9505Kc.

CENTRAL AFRICA Republic, with broadcasts from Bengui, is now on the air from 3.30 to 4.30 p.m. on 5035Kc., 9.30 to 10.30 p.m. on 9515Kc., and 3 to 6 a.m. on 5035Kc., with 4Kw. on both frequencies.

NIGERIA has a new station, Eastern Nigeria Broadcasting Service, Enugu, which operates from 3 to 6 p.m., on 4855Kc., 8 to 11.30 p.m. on 9635Kc., and 1 to 8.30 a.m. on 4855Kc. This is an independent radio and television station, partly owned by the Eastern Regional Government and partly by British interests, and has no connection with Nigeria Broadcasting Service. Has been heard in New Zealand from 4.30 p.m., when it relays the programs of the B.B.C. in London.

NETHERLANDS Happy Station program, which features Eddy Startz at the microphone, is broadcast on Sundays from Hilversum. The present schedule is: To Australia and New Zealand, 8.30 to 10 p.m. on 6020, 17775, 21565Kc.; on Monday to Africa and India, from 2 to 3.30 a.m. on 6020, 21480, 21565Kc., 7 to 8.30 a.m. to Europe, when the frequencies are 6020, 11950, 15425Kc., and again from noon to 1.30 p.m., on 6025 and 9590Kc. to North America. The Dutch program to North America is heard from 11.30 a.m. to 1.30 p.m. on the new frequency of 6085Kc., as well as on 9715Kc.

MAURETANIA, in West Africa, has a new station at Aioun el Atrouss and relays the main St. Louis program from 5 to 6 p.m., 10.15 to 11.30 p.m., and 5.55 to 9.45 a.m. on 5055Kc., with 250w.

BUCHAREST, in its broadcasts to Europe in English, is on the air from 5.30 to 6 a.m. on 6100 and 9510Kc., 7 to 7.30 a.m. on 9510, 7195Kc., and 8.30 to 9 a.m. on 5990 and 7195Kc.

GOA has commenced transmissions in the 13-metre band, from 7.30 to 8.30 p.m. in Portuguese, and from 8.30 to 9.30 p.m. in English, on 21580Kc.

CONGO REPUBLIC, from Leopoldville, has been noted in the U.S.A. from opening at 8 a.m. to sign-off at 10 a.m. on 11755Kc. The station identifies, "The Heart of Africa calling the World. This is Leopoldville, the National Broadcasting network of the Republic of the Congo." The station was asking for reports to Box 3171, Leopoldville, Republic of the Congo.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Eastern Australian Time.

GRENADA, the home of the Windward Island Broadcasting Service in the city of St. George, has been noted on two new frequencies. The station transmits from 7 to 9 a.m. on 15400Kc., 9 a.m. to 12.15 p.m. on 11715Kc., and has been widely reported in North America to sign off at 12.15 p.m. on 11715Kc. The power used is 250 watts.

RANGOON, Burma, has been heard by N.S.W. listener Kevin Dunham from opening at 9.30 p.m. on 4795Kc., with Western music, then Burmese from 10 p.m. The English news was also noted at 12.30 a.m., on 6035Kc. This session concludes at 1.15 a.m., when the station signs off the air.

GHANA, which has four 100Kw. transmitters being installed near Accra, has been noted on test at 2.30 a.m. on 15190Kc. A further test from 5 to 6 p.m. has been noted on the old frequency for Accra of 9640Kc.

RHODESIAN signals from Lusaka have been heard when the station has news in English at 1.30 a.m. on 9570Kc., the news having also a vernacular translation. Station left the air at 1.45 a.m.

JORDAN, with its new 100Kw. transmitter, continues to be received at good strength in this area, and in the afternoons signals can be heard from sign-on at 4 p.m. to sign-off at 7.5 p.m. on 9530Kc. The Hashemite Broadcasting Service in Amman is also using 7155Kc. from 5 to 8 a.m., with a further broadcast in Arabic.

GOA, in Portuguese India, has been heard on the off band frequency of 21858Kc. from 1.30 a.m. by English listener Sydney Pearce. The station has popular music to 1.50 a.m., then followed news in Portuguese, and light music from 2 to 2.30 a.m.

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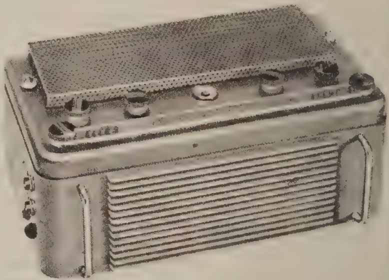

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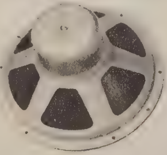

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For Photo-enthusiasts:

The New Film Speed

In photographic circles at the present time one of the most discussed subjects is the proposal to modify the present ASA method of expressing film speed. Opinions appear to be fairly sharply divided on the issue, one group maintaining that the change is unnecessary and can only cause confusion, while others claim that the new ratings are more realistic and in keeping with current practice anyway. Just what is it all about?

by Philip Watson

EVER since the very earliest days of photography, when Messrs. Hurter and Driffield endeavoured to put film speed on a scientific basis and established the "H and D" system, there has been confusion over this very vital subject.

Particularly in the early days, when films were relatively insensitive, the all-important factor, as far as the photographer was concerned, was the speed of the film. And, of course, the film maker who could boast the highest film speed would have a better chance of selling his product.

MANY SYSTEMS

Thus commenced the battle of the film speeds and speed rating systems. Unfortunately, Messrs. Hurter and Driffield, while making a significant contribution to the art at the time, left something to be desired in their system. Other workers evolved better methods but, again, unfortunately, retained the designation "H and D." The result was a number of so-called H and D systems operating side by side and quoting vastly different figures for the same film.

While most amateurs soon learned to distinguish between them, the situation was not a happy one. And it was not made any happier by the gradual emergence of other systems, such as Scheiner, DIN, etc., which, while well thought out and genuinely aimed at ending the confusion, seemed only to add to it.

These systems grew to such an extent that, just prior to World War II, there were over half a dozen in common use, including H and D (British) H and D (European), Scheiner, DIN, Weston, etc., plus a host of minor ones sponsored by individual film companies, meter manufacturers, and even photographic chemical companies!

No wonder the amateur was confused.

WARTIME PROBLEM

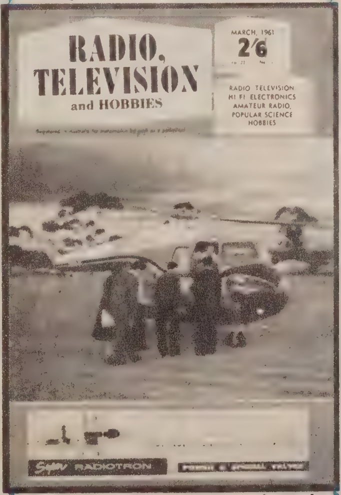
Early in the war it became apparent that photography was to play a big part in the Armed Services, and the need for a standard film speed system was urgent. To satisfy this need the American Standards Association produced a completely new system, eventually to become known simply as the ASA System.

(At the same time the British Standards Association came up with the BS System, a rationalised version of Continental systems in use at that time. This ystem is still popular in Britain and Europe.)

After the war the ASA system found wide acceptance by the photographic trade and photographers generally. It was easy to use, close enough to be interchangeable with popular meter systems already in use and, above all, it was a true standard, evolved by an independent organisation and acceptable to virtually all film manufacturers.

NEW LOOK FOR "RADIO, TV & HOBBIES"

Don't be dismayed, next month, if the old, familiar "Radio, Television and Hobbies" appears to be missing from your newsagent's sales counter. It will be there, all right, but with a "new look."



As from the next issue, the red and blue cover which has been current, with variations, since 1939, gives place to a handsome new design in four colours.

Don't miss out. Order your copy now.

Better still. Play safe and instruct your newsagent to put your copy aside, or deliver it to your door, every month.

At long last the confusion seemed to have ended.

But had it? BS and DIN were still popular on the Continent and presented a real threat to a truly worldwide standardisation. Nevertheless, the ASA system continued to hold its own and is now widely accepted.

Why then, the proposed changes?

Briefly, the changes—there are two—are aimed at (1) correcting obvious anomalies in the present system (to become effective immediately), and (2) producing a truly worldwide standard incorporating the best features of the current systems. (A long-term proposal to be introduced gradually.)

In order to get a clearer picture, let us consider the two proposals separately. This is logical, anyway, since they are not really related.

FIRST CHANGE

First, the change in the current ASA ratings. Several points need to be emphasised in this regard, as follows:

(1) The proposed change affects only continuous tone, monochrome negative material. It does NOT involve colour, monochrome reversal, or high contrast line copying films.

(2) It does not mean any change in the films themselves, which remain exactly as before.

(3) Because of (2) there is no need for the individual to change his present operating technique, if it is giving satisfactory results.

In terms of the actual ASA figures, it will take the form of an approximate doubling of the current ratings, i.e., an exposure one full stop smaller than previously calculated. Thus, 64 ASA will become 125 ASA, 200 ASA becomes 400 ASA, etc.

(The BS system is being similarly uprated. BS 29° will now become 32°—an increase of 3° represents one stop—and BS 34° becomes BS 37°.)

This has come about simply as the result of the re-appraisal of the method of determining film speed. Until now, ASA (and BS) ratings have incorporated a safety factor of approximately 2.5 to 1, meaning that, after determining the minimum exposure required for a first quality picture, a rating was chosen which would produce more than twice this exposure.

GOOD REASON

The reasoning behind this was logical enough. Negative materials normally have a very wide exposure latitude and can easily stand the extra exposure without serious consequences. On the other hand, it provides a useful margin of safety to guard against cumulative errors in lens efficiency, shutter inaccuracies, meter inaccuracies, processing variables, etc.

At least, that was the theory. In practice, most amateurs (except those for whom the safety margin was working to advantage) soon realised that their negatives could be given less exposure, and made good use of the fact. Apart from effectively increasing the speed of the film, reduced exposure produces lighter negatives, easier to use in the enlarger, and having less grain.

The safety margin also resulted in some exaggerated claims being made for (supposedly) new developer formulas. These were, in most cases, only minor

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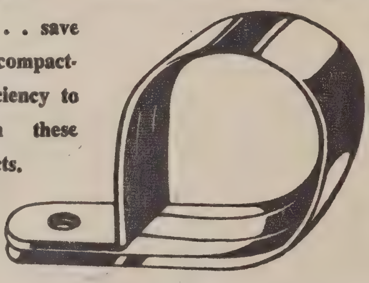

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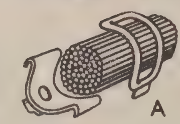
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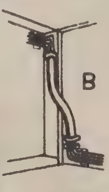
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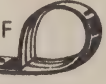
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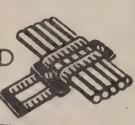
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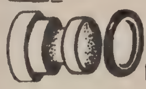
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variations of standard mixtures, but their creators — often in ignorance — took advantage of the conservative rating to support these claims.

Since experience has shown that the safety margin was much less necessary (or even desirable) than was originally anticipated, it has been decided to drop most of it and rate films for near minimum exposure. The individual may still modify a rating if preliminary test shows that his equipment or method of working require it.

If more information is required, with specific ratings quoted, both Kodak and Ilford have pamphlets available on request. The Kodak pamphlet is entitled, "About The New Film Speeds," while that from Ilford is, "Revised Meter Settings For Ilford Negative Materials" (Technical Service Note No. 1/60).

As for the criticism that has been levelled at the idea, this probably is valid on the basis that it will cause some confusion. However, the same criticism can normally be levelled at most changes, no matter how much benefit they confer. (Witness the confusion caused by the preferred values for radio components.)

NO PROBLEM

On the other hand, adequate publicity should keep this to a minimum and, in any case, little serious harm will result if one rating should be confused for the other during the transition period.

What is more important, the change is only a recognition of what most photographers already know and have been practising for some time. To continue to ignore such a situation would only weaken the respect which this standard has enjoyed thus far.

(It is significant that some film manufacturers have, for some time, been advising their customers that the ASA rating of their films could safely be doubled in those cases where reliable equipment and processing was assured.)

The second proposed change is a proposal to replace the present arithmetical scale with a logarithmic scale, which will use the figures 1 to 10 (expressed in degrees) to cover the full range of film speeds. It is not proposed to change to this immediately and films will currently be rated with the new arithmetical number, followed by an oblique stroke and the logarithmic number. Thus, a film previously rated at 200 ASA will now be rated as 400/7°.

FUTURE SYSTEM

This system is intended for use as and when cameras and exposure meters become available carrying the new rating, which it is hoped will be accepted on a world-wide basis. Only brief details are available at present and lengthy comment would be out of place. In any case, this rating may be ignored until there is a use for it, the first half of the combination being used in place of the old ASA number.

So, in summary, we have:

(1) An official acceptance of a situation already well known and widely practised, and

(2) A new system to be run parallel with the present system until it can be firmly established on a world-wide basis.

Not a great deal to become confused over, really!

ONE TRANSISTOR RECEIVER

(Continued from Page 79)

there is the collector end of the reaction winding and the connection to the .0015 mfd capacitor.

To attach the completed loopstick aerial to the matrix board, we looped a scrap of heavy gauge nylex tubing around each end, securing it in place with a nut and bolt.

A metal strap forming a short-circuited loop must not be used, as it will completely upset the performance of the tuning circuit.

It may be found that the higher frequency broadcast stations tend to crowd towards the centre of the tuning range, due to the very low capacitance in the tuned circuit when the plates are out of mesh. The frequency coverage of the set can be reduced and the stations spread out by connecting a 50 pF. trimmer capacitor across the tuning gang and adjusting it to produce a suitable "bandspread."

This trimmer, which is an entirely optional component, is not shown in the photograph and is dotted in the circuit.

Extremely good results were obtained with an aerial and earth. However, when operated in what might be called a favourable locality, it gave worthwhile results on all local stations without the need for either. Best results will be obtained when the rod is horizontal and perpendicular to the line of direction to he station.

When an aerial is used, the coupling between the aerial and tuned winding should be adjusted to suit its individual ength, otherwise a long aerial will tend to affect selectivity adversely.

If connection of the aerial causes the stations to overlap unduly, try reducing he number of turns on the aerial primary winding. Note that with a battery ype receiver, the benefits of an external aerial are never realised fully until an earth also is connected.

EARPHONES

And here is a final word about earphones and earpieces.

Undoubtedly the best results are to be had from standard "high impedance" earphones, the term usually describing phones with a nominal impedance of about 2000 to 4000 ohms. At the same ime, these do vary a good deal in efficiency, depending on their manufacture and their age.

Next best, in terms of performance, and often cheaper to buy, are the so-called "low impedance" ex-disposals headphones, having a nominal impedance of about 400 ohms.

Ex-disposals dynamic headphones, the ype used with earmuffs and with an mpedance of about 45 ohms are not suitable for this set.

In the matter of hearing-aid type earpieces, two types appear to be commonly available at the moment.

Of these, the magnetic unit, with an mpedance of about 8 ohms, is quite unsuitable because of the large impedance mismatch and the fact that they would ppear to be rather insensitive, anyway.

The crystal type earpiece, which also appens to be the cheaper of the two, is a somewhat better proposition. However, being crystal, it has no internal DC circuit and must be used with a parallel resistor and blocking capacitor, as indicated in the supplementary circuit on page 77.

With this arrangement, the sensitivity is still not to be compared with good quality high impedance earphones. Therefore, in weak signal areas, or if you want to use the set without an external aerial or earth, earphones are recommended.

However, the crystal earpiece is cheap and compact and would be ideal for anyone wanting to use the receiver for listening in bed, etc. If you want to use the crystal earpiece therefore, you will have to put up with some loss of sensitivity. This may mean adding a small external aerial and an earth to boost the signal strength in marginal areas.

In a forthcoming issue, we plan to show how an additional transistor can be added, which may make the crystal earpiece a much better proposition, as well as boosting the performance of the receiver generally.

TV AND THE EYES

Television is not harmful to the eyes if the set is correctly adjusted, and used in reasonable illumination and not to excess, says the Journal of the Association of Optical Practitioners. It adds, however, that "the child, or even the adult, who stays up late every night watching television in a darkened, stuffy room, probably filled with cigarette smoke is quite liable to complain of eye fatigue." The journal's statement follows a survey which says "There is no evidence to suggest that television was responsible for an increase in the number of children with squints. ("Evening News").

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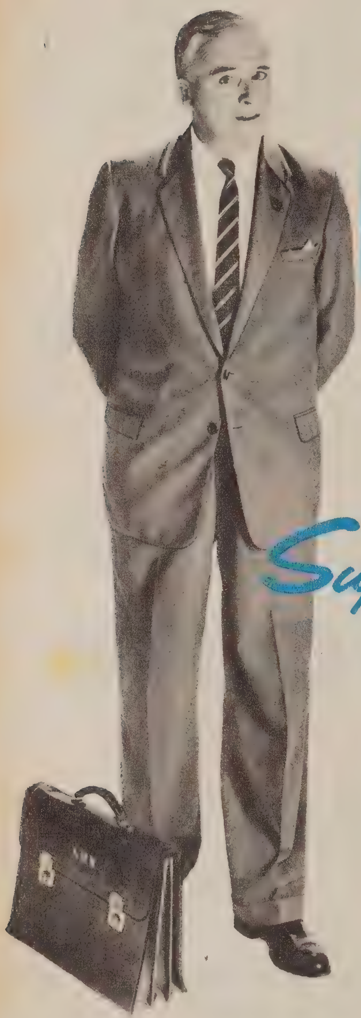

THE MAN SAID REPLACE IT WITH A NEW *Super* RADIOTRON PICTURE TUBE

I'm a businessman, and while I wouldn't dare admit it to m wife, I know nothing about the workings of our TV set, ev though we've had it almost four years. For that reason, wh the picture tube needed replacing last week, I told the Servic man that I wanted the best possible picture tube available Australia. One that was not only reliable, but also backed a firm that offered immediate replacement and round-the-clo expert service and testing. After mentioning these points alo with a price that I would be happy to pay, the man sai *"Replace it with a Super Radiotron Picture Tube."*

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ANSWERS TO CORRESPONDENTS

RATIOS IN A MUSICAL OCTAVE

G.J. (Alice Springs) asks if we can answer a question on music. He notes that one octave represents a frequency ratio of 2, but wonders if there is any easy relationship between the notes of one octave.

A.: There is a relationship between the frequencies of the notes in any one octave, G.J. That is, one octave of the tempered diatonic scale of C Major, such as one finds on the piano keyboard between one white (natural) C key and the next white C key. There are many other scales, but this is usually the one referred to in discussions. (By tempered we mean that the black keys are really compromise notes, being neither the sharpened lower note nor the flattened higher note, but a mean of the two).

We have set out the frequency relationships for any given octave of the scale of C Major below. The table is normalised, so that the lower C is taken as one. To find the actual frequencies of the notes in any octave, multiply all the figures by the frequency of the lower C.

C	1.00000
Cshp,Dflt	1.05946
D	1.12246
Dshp,Eflt	1.18921
E	1.25992
F	1.33484
Fshp, Gflt	1.41421
G	1.49831
Gshp, Aflt	1.59740
A	1.68179
Ashp,Bflt	1.78180
B	1.88775
C	2.00000

A. R. (Ascot Park, S.A.) says he was very interested in a recent article on transistorized electrical systems for cars. He wants to know whether we could offer further technical assistance.

A.: This article was drafted by an independent contributor, who is not in any way connected with our staff. Work on this technique is at a relatively early stage and we gather that there are quite a few practical problems yet to be solved before it will displace the conventional system. At the moment we are not able to offer any assistance.

W. G. N. (Katoomba, N.S.W.) says he has made a start in building radio equipment as a hobby, but he is very interested in aircraft movements and radio traffic relative thereto.

A.: We are glad to welcome you to the ranks of radio set builders and trust that you will obtain a lot of pleasure therefrom. We imagine that it would be possible to obtain disposal equipment which could be adapted to monitor aircraft control channels. We have heard such traffic at times, more or less by accident, but have never made it our business to list the channels and frequencies involved, let alone state the conversion equipment to receive same. This being the case we are not in a position to offer any assistance.

T. McK. (Gymea, N.S.W.) says he has been able to extend the range of his portable set by attaching to it a flexible steel tape, which serves very well as a Telescope Aerial.

A.: Thank you for your letter and your practical interest in the magazine. We may be able to make use of your suggestion in our "Reader Built It" page.

R. W. T. (Hamilton, N.S.W.) says he has built a commercial kitset similar to our "Transporta Seven" and asks advice on certain points.

A.: We are always wary about kitsets which are merely similar to our designs and we certainly cannot accept any responsibility for how they may operate.

In this case, different transistors have been used and there is no guarantee that coils and IF transformers are equivalent to those originally used. We are inclined to believe that the whistle you mention, present only at night, is the ordinary heterodyne whistle heard between adjacent stations. This could indicate some lack of basic selectivity or the need for more accurate alignment. AVC action in the original set was very effective but whether the same AVC system is used in your kitset is another matter. We would stress, however, that on weak stations and using a loopstick aerial it may not be possible for any AVC system to eliminate fading completely.

K. P. (North Shields, S.A.) asks if we can offer any explanation for an apparent improvement in reception of a table radiogram when an inoperative portable nearby was tuned to the same station.

A.: We find this rather surprising, K. P., and have not heard of the occurrence before. The only suggestion which we can offer is that the tablegram had a rather inefficient aerial system so that if the aerial system of the portable reradiated some signal, it could increase the signal input to the tablegram. This would be due to the relatively high efficiency of the ferrite rod aerial used in the portable.

M. H. O. (Lismore Heights, N.S.W.), asks if it would be possible to construct an electronic tachometer using the new numerical indicator tube type Z510M, which was reviewed in the July issue of the magazine.

A.: We imagine that it would be possible, M. H. O., but it would probably involve either complex relay circuitry or a servomechanism to convert the voltage output from a conventional tachometer circuit into the digital form needed for the indicator tube. At present, we feel that either of these procedures is rather beyond the home constructor if only due to the scarcity of suitable components. and time to develop the circuitry.

RADIO, TELEVISION AND HOBBIES QUERY SERVICE

TO assist our readers, "Radio, Television and Hobbies" conducts a technical query service. Conditions governing this service are set out below:—

(1) Requests for copies of circuits or technical queries requiring an answer through the post must be accompanied by postal note or stamps to the value of TWO SHILLINGS. Queries not accompanied by a fee will be answered in rotation on these pages.

(2) For the 2/ fee, we will supply circuit data, as available, for up to three projects. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. As a rule, requests for circuits will be answered more speedily if they are clearly identified and not complicated by questions requiring the attention of technical personnel.

(3) The technical query service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits.

(4) The Editor reserves the right to return query fees or to limit the scope of an individual reply, where it is felt that a partial answer will be better than none at all. Please note that the inclusion of an extra fee does NOT entitle correspondents to special consideration.

(5) In addition to the normal query service, chassis blueprints are available for most of our projects, showing the position of all holes and cutouts for metal-working but containing no details of wiring, etc. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost 5/ each. Original photographs of most projects are also available, from 5/ for a 6in x 8in glossy print; postage 9d extra.

(6) Letters should be addressed to the Technical Editor, "Radio, Television and Hobbies," Box 2728, G.P.O., Sydney.

(7) "Radio, Television and Hobbies" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications of merchandise must be obtained from our advertisers.

(8) Technical queries are not answered by telephone.

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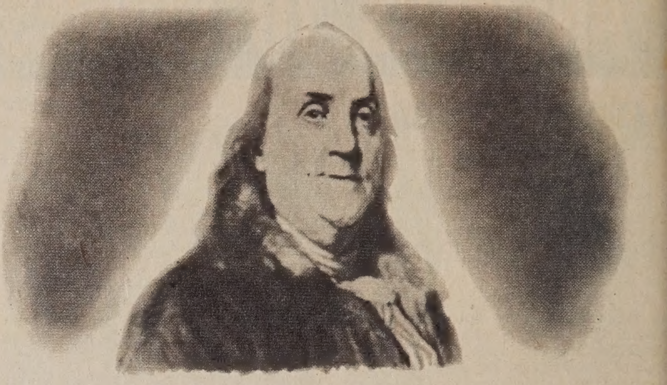

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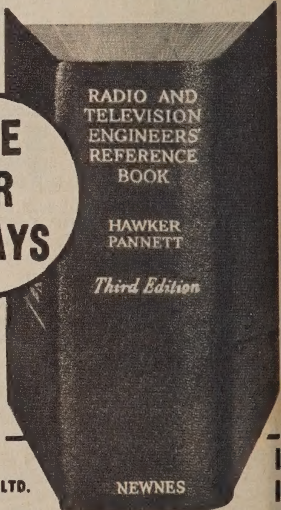

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VALVE TESTER

(Continued from Page 71)

Having investigated various approaches, it would seem that the best is to record the data on loose sheets punched to fit a standard octavo size loose-leaf folder.

The accompanying illustration shows how the data can be recorded in columns ruled on standard octavo size refills.

In fact, it is likely that constructors will be saved the chore of ruling their own pages, one of our advertisers having indicated an interest in making suitable punched sheets available, ruled with the appropriate columns.

In the selector switch columns, "T" indicates switches in the test position, "F" indicates the Filament position, "O" indicates Open and "S" indicates switches that will normally show a short when placed in the test position.

The pages measure 8in by 5in, and, using both sides of the sheet, will allow approximately 10 valves to be listed per page. A simple folder will comfortably hold 100 sheets so that there is room for around 1,000 valves to be listed altogether.

As soon as the printed sheets are available, we will advise accordingly.

OPTICAL ADAPTERS

(Continued from Page 69)

Physically, this pre-amp is built on a chassis and case very similar to that used for the "Unit Stereo Amplifier No. 1" and the "Playmaster Tape Adapter" of last month. In fact, the case for all these units is identical — only the chassis and front panels of the units differ.

There are only two controls on the pre-amp front panel; the treble control on the left, and the volume control on the right.

Above the chassis, there is plenty of room without overcrowding. At the left is visible the 12AU7 amplifier and cathode follower valve, followed by the EF86/Z729. At the far right is the exciter lamp power supply choke and rectifier. At the rear of the chassis, from left to right, the components visible are the amplifier inter-connection cable, the photocell voltage pot., the exciter lamp connector and the shielded connector for the photocell.

The underchassis view shows the layout of minor components. Placement of these should be fairly obvious from the photograph, as should much of the wiring. The wiring of the original should be adhered to fairly closely, to ensure stability and freedom from hum.

As far as possible, employ single point earthing for all the amplifier circuitry. In the prototype, we attached the amplifier earth busbar to the chassis in one place only, namely at the centre lug of the 5-lug tagstrip between the two valve sockets. The earth connections of both stages were taken to the busbar, with the exception of the cathode components of the first half of the 12AU7.

All heater wiring should be twisted, to minimise hum radiation. Incidentally, you will notice that the circuit shows a dotted earth connection for one side of the heater circuit. In our main amplifier, the heater circuit was already earthed at the transformer centre-tap, making the extra connection unnecessary (if not stupid!). In any case, the heater circuit should not be left floating, but should be tied down to earth either as shown in the circuit or by an existing connection in the main amplifier.

To provide connection to the main amplifier we have shown an octal plug, with the necessary connections for operation with a standard "Playmaster" power amplifier. However, the pre-amp can obviously be used in conjunction with any suitable amplifier, merely by changing the connections to suit.

To summarise then, this pre-amplifier unit can be used with most amplifiers of reasonable quality to produce very acceptable sound from 16 mm optical sound films. The actual quality achieved will depend, of course, upon the machine used and its sound head, but the unit which we have described should provide a good basis for experimentation.

Both units described should enable owners of aging equipment, whether professional 35 mm or 16 mm, to improve the quality of their sound.

THE R., TV & H. CROSSWORD No. 82

1		2		3	4	5	6		7	8	■	■
	■		■	9				■	10		11	■
12			13					■	14			15
	■	16				■		■	17			
18	19									■	20	
21				■		■		■		■	■	
	■		■	22		■	23	24				
	■	■	■		■	25				■	■	
26	27	28	29		30	■	■	31		32	■	
33											■	
34		■	35			■	■	36			37	
38		39		■		■	■		■	40		
41				■	42							

ACROSS

1. The degree to which a receiver differentiates between signals.
9. Contest.
10. Over (Poet).
12. It measures resistance.
14. Fastener.
16. Vessel.
17. The eagle.
18. This tube has a heated cathode.
20. Short for the U.S. capital territory.
21. Have concern for.
22. Symbol for silver.
23. A type of power.
25. In good condition.
36. Country.
31. Medical men (abb.).
33. A joining together.
34. Pronoun.
35. Small child.
36. Surname of a film star.
38. Observe the rhythm.
40. Ahead of.
41. Blemish.
42. Sets free.

DOWN

1. Low resistance connections that allow the current to return to the source without flowing through the normal loads.
2. A unit of brightness.
3. Colour.
4. Making edges by hand.
5. One type contains coconut.
6. Girl's name.
7. A means of emphasising high or low notes at will.
8. Period.
11. Outer surface.
13. Additional amount.
15. A device for the measurement of short wave lengths.
19. Ejaculation.
22. The sound, not the picture.
24. It can be heard.
27. Grotesque
28. Stands for part of New Zealand.
29. Following.
30. Player.
32. Breaks.
37. Anger.
39. Degree.

Last month's solution

D	I	R	E	C	T	C	U	R	R	E	N	T
I	■	E	■	A	■	■	N	■	U	■	■	R
E	X	C	I	T	A	T	I	O	N	■	■	I
L	■	I	■	H	■	■	O	■	I	■	■	P
E	X	P	L	O	R	I	N	G	C	O	I	L
C	■	R	■	D	■	N	■	A	■	I	■	E
T	R	O	V	E	■	C	O	M	P	L	E	X
R	O	C	■	B	■	U	■	M	A	Y	■	C
I	D	A	■	I	N	R	O	A	D	■	■	A
C	■	L	E	A	■	S	■	R	■	C	O	B
■	A	S	P	S	■	I	R	A	T	E	■	L
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